MODERN PLASTICS

OCTOBER 1946

NEW DESIGN TECHNIQUE INCORPORATES DUREZ

Convincing evidence of the modern trend towards functional design is effectively revealed in these illustrations of the old and the new Belfone "Maestro" intercommunication units.

Notice how the hard, "mechanical" look of the prewar Belfone has been replaced by an attractive molded Durez plastic housing that gives this new product an air of superior quality, as well as supplying it with many other physical benefits required by the manufacturer.

What This User Wanted

In this connection Mr. Floyd W. Bell, President of Bell Sound Systems, Inc., comments interestingly . . ."Our new design offers many functional advantages in addition to its beauty. The rounded top of the new Belfone eliminates the natural tendency to pile papers and other material on top of it, building up insulation and hindering the free circulation of air. Since the many curved surfaces and encircling louvers would be impractical in wood, the cabinet is being molded of Durez. Its over-all attractiveness makes it suitable for use on the finest executive desk. The durability of Durez ends for all time the many disadvantages of old-fashioned flat-top housings and the scratching to which wood is susceptible. In addition, its imperviousness to atmospheric conditions provides undiminished lasting beauty."

Unlike other housings of this type which are molded in one piece with an open bottom or back, the new Belfone housing consists of two pieces comprising the front and back sections. These are molded separately and assembled with molded end flanges in a slot. Molds for producing this unique construction were developed by Bell engineers in cooperation with the Plastics Division of Continental Can Co.

What You Can Get

The general-purpose Durez plastic used is one of more than 300 multi-propertied molding compounds developed by Durez laboratory engineers. Heat resistance, dielectric strength, non-resonance, and impact resistance are some of the important characteristics inherent in all Durez phenolic plastics.

We'd like to work on any of your problems that phenolic plastics may solve. The competent counsel of experienced Durez technicians, as well as a library of proved product development data, awaits your enquiry.

Durez Plastics & Chemicals, Inc., 510 Walck Road, North Tonawanda, N. Y.
Export Agents: Omni Products Corporation, 40 E. 34th St., New York, N. Y.

DUREZ

PHENOLIC RESINS

- MOLDING COMPOUNDS
- INDUSTRIAL RESINS
- OIL SOLUBLE RESINS

PLASTICS THAT FIT THE JOB

TECHNOLOGY DEPT.

Pleasant Playing Ahead—with *Catalin* as a Party to the Enjoyment

Just one glance at this ingeniously designed display of Catalin color, and you are irresistibly drawn into the spirit of the occasion!

Kard-Aid, as produced of Catalin, by Selwyn Manufacturing Co.*, individually plays up to, as well as for and with all of a game's participants. It lends a warm feeling and very welcome hand to good fellowship get-togethers.

Each player's chip rack . . . in sets of four or six . . . is contrastingly toned. The chip channels tip forward slightly, hug close to the table top, and thus facilitate stacking and withdrawing. The chips, featuring richest Catalin colors, are flawlessly finished, sleek, inviting to the touch. The flush-seated metal ash tray components (forgive us the acknowledgment) are removable.

Catalin, the gem-like cast-phenolic, so beautiful unto itself, is certain to enhance the sales and decorative appeal of any product to which it serves as a whole or part. Its speedier availability, too, without recourse to expensive tooling, accords it preference among manufacturers.

Catalin's advantages are many, so many, that the members of our service staff would enjoy assisting you personally in planning your proper and most profitable use of *the gem of plastics.* Inquiries invited!

CATALIN CORPORATION OF AMERICA
ONE PARK AVENUE • NEW YORK 16, N. Y.

*Selwyn Manufacturing Co., 48 W. 27th St., New York, N.Y.

CATALIN
THE GEM OF PLASTICS
Catalin

CAST RESINS • LIQUID RESINS • MOLDING COMPOUNDS

MODERN PLASTICS

VOLUME 24 OCTOBER 1946 NUMBER 2

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"EXECUTIVE and EDITORIAL OFFICE: 122 E. 42nd St., New York 17, N. Y. Published the 20th of preceding month by Modern Plastics, Inc., at Publication Office: Twentieth and Northampton Sts., Easton, Pa. Entered as second class matter, May 28, 1940, at the Post Office at Easton, Pa., under the act of March 3, 1879." Copyright 1946 by Modern Plastics, Inc. All rights reserved. Subscription $5.00 a year, $8.00 for two years in U. S., its possessions and South America. Canadian subscriptions $5.50 per year. All other countries $6.00 per year, payable in New York funds.

Some more of the thousands of applications for GEON raw materials

THEY'VE made fly swatters and shower curtains—upholstery and floor tiles—wire insulation and acid tank linings—and thousands of other useful, attractive products from GEON polyvinyl raw materials. Here are some more—raincoat, hat, matching handbag, shoes, suitcase — colorful, nice to look at, long-lasting, easy to clean.

GEON, as can be seen, is an extremely versatile material. That's because of its unusual properties which may be compounded into finished products in a wide variety of combinations. Products made from GEON may be made to resist water, chemicals, sunlight, heat, cold, oils and greases, abrasion, mildew, ozone, and most other normally destructive factors. They may be flexible or rigid, clear or opaque, brilliantly or delicately colored.

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For more information about GEON, please write Dept. I-10, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

Products shown are made of Pantasote's Pantex and Pantasote's Wynsote.

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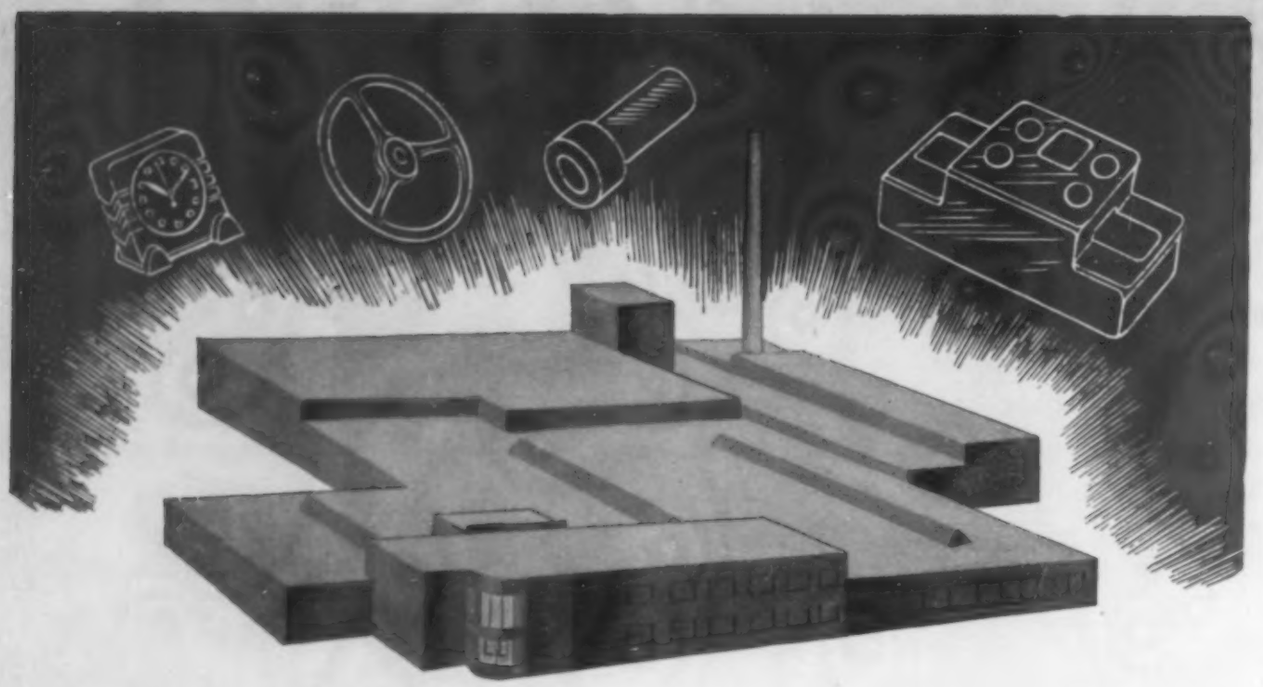

Our PRODUCT IS *Your* PLASTIC MOLDED PART

EVERY square foot in this modern 2½-acre plant is devoted to one purpose . . . producing our customers' plastic parts.

We make no products of our own, nor do we contemplate making any. We have nothing to sell to jobbers or retailers; so we never compete with the manufacturers we serve. Custom molding is not a sideline with us . . . it is our *only* business.

Every machine in our spacious tool room . . . every one of our scores of presses . . . every man in our organization . . . has but one job—to produce molded plastic parts that will meet our customers' most exacting requirements. And our success, for more than a quarter century, has been built on doing that job well.

That, perhaps, is one of the most important reasons why CMPC's list of customers reads like a bluebook of American industry . . . and why you, too, will find this a good place to come for your plastics parts.

May we discuss your next plastics job with you, without obligation on your part? Just ask for a CMPC Development Engineer.

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Member Audit Bureau of Circulation
MODERN PLASTICS is regularly indexed in Industrial Arts Index and Industex.

Poison darts

Among the plastics news items of the past month was one that has sinister implications. The item read: "Plastics, the wartime material for clocks, compacts and junk jewelry, has virtually gone into the discard."

It appeared in a Chicago newspaper. Doubtless written by a reporter after an interview with some person who had an axe to grind, it is only one of an ever-increasing number of poison-coated darts that have been aimed at the plastics industry.

We admit that there have been many misapplications of plastics in the jewelry and cosmetic fields, bumbles of a few indiscreet processors which are returning to plague the entire industry. However, any indication that plastics have been discarded by one or all of the three fields mentioned here would come as a great shock to the hundreds of workers and scores of proprietors who are presently engaged in overtime operation to meet the demand for their handiwork.

Cellulose acetate, polystyrene, urea and the acrylics are used in great quantity for jewelry, compacts and clocks. It is interesting to note that production of acetate molding materials increased from around 5,000,000 lb. monthly a year ago to about 7,000,000 lb. in June. Over the same period polystyrene increased from less than 1,000,000 lb. to almost 6,000,000 lb.; urea from a scant 2,500,000 to well over 3,000,000 pounds. If none of this material is going into the above-named products which, according to the news item, were produced exclusively from plastics during wartime, it is comforting to know that such a lucrative market could be lost to the industry without its even realizing that it was gone. It seems peculiar that the producers and processors of clocks, compacts and jewelry would continue to turn out thousands of a supposedly "discarded" item.

Actually, plastics were no more the wartime material for these products than wood, glass, metal, ceramics, et cetera. With from 80 to 90 percent of wartime production allocated to war or essential items, there was little plastic left over and it was divided in mere flea-bites amongst many end uses.

Today, despite the Chicago news item, low cost jewelry is still made of plastics for outlets demanding low cost goods. But plastics are probably being used in smaller quantity, and for products that are no better or no worse, than are other materials fabricated for this particular market. They are also used for extremely high quality jewelry by manufacturers who produce equally beautiful jewelry in other materials.

As for compacts, there are many women who prefer them in plastic, despite the plentitude of metal. The reasons are color, functionability, lightness and economy of price.

Thermosetting plastics proved their adaptability for clock cases before the war. The public continues to demand them year after year in face of the stiffest competition from other materials. To assert that they have been discarded is akin to saying that goat meat has superseded beefsteak in public favor.

The plastics industry should be on the alert to challenge statements that undermine its sales appeal. The day of rugged competition with no holds barred is approaching. Let the seller beware lest his buyer be lost to a loud-mouthed rival having his tongue in his cheek.

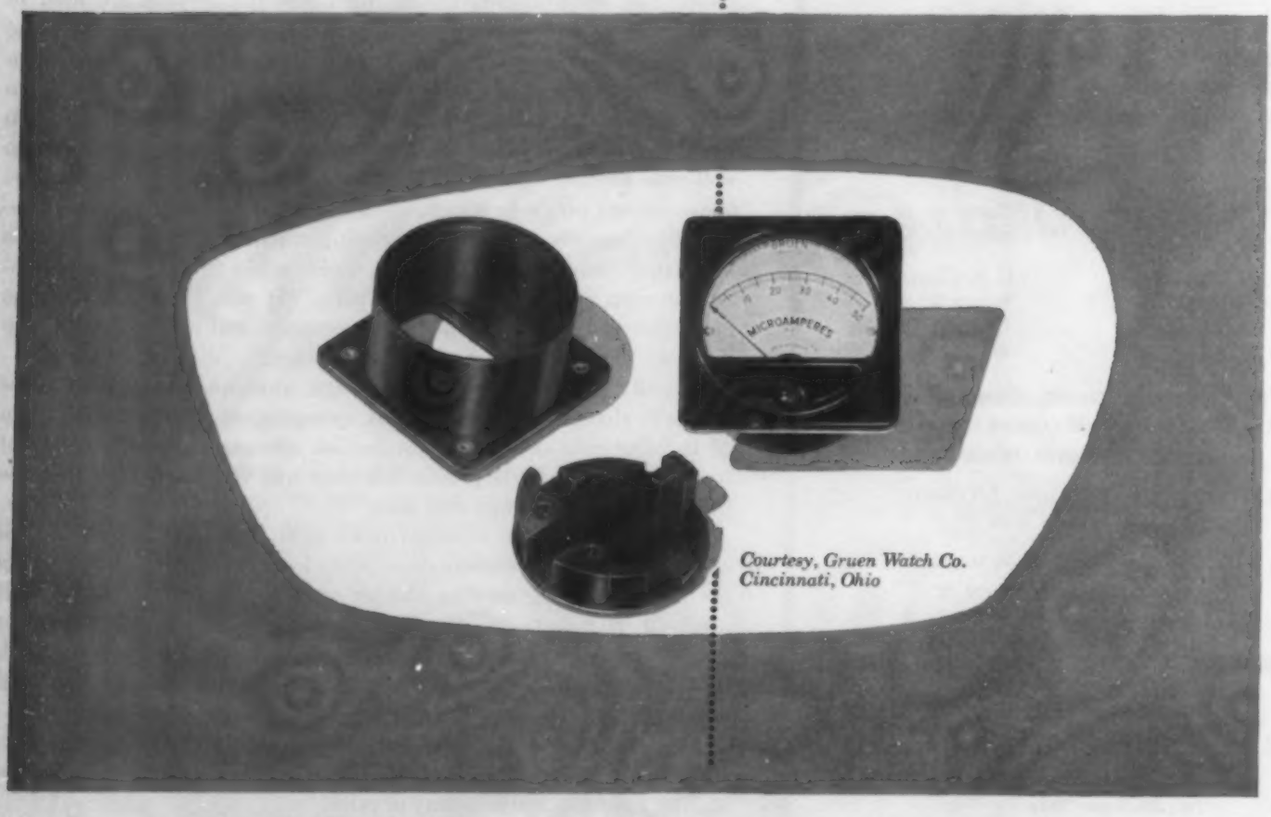
Case Histories from the **RICHARDSON** *files*

MOLDED PARTS

Problem: *Produce a case for vital electrical indicating instruments. Must be lightweight, durable, high in dielectric strength and have a permanent finish.*

Solution: *Richardson Plasticians* used Molded INSUROK, Grade 1, finding in this specific grade and type a material ideally suited to the requirement. The result was a meter case having the precise characteristics desired.

Richardson Plasticians are well equipped to help you solve your plastic problems—whatever they may be. For in the large family of INSUROK *Precision Plastics*, there is a type and grade to meet practically any requirement. Next time let us mold or laminate the kind of INSUROK you should have for better efficiency on your job.



Courtesy, Gruen Watch Co.
Cincinnati, Ohio

INSUROK *Precision Plastics*

The RICHARDSON COMPANY

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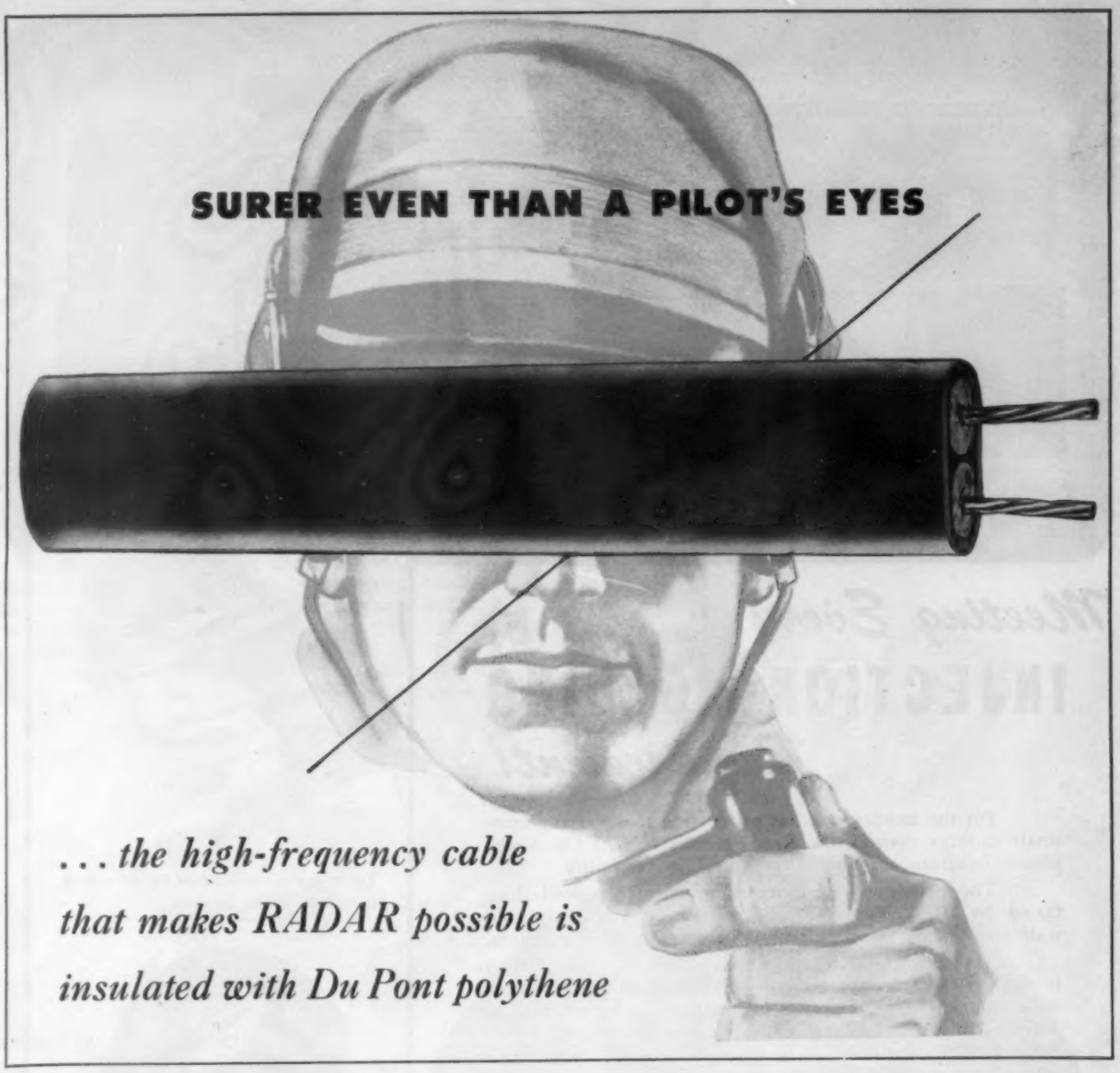

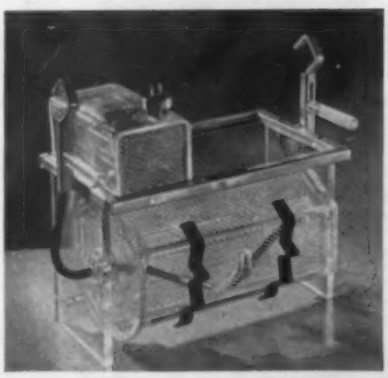

WHAT'S NEW. Tumbling barrel of "Lucite" used for plating small pieces. Has seamless edges, provides many advantages for industry, including inertness to caustic plating solutions, durability, light weight, and low electrical conductivity. Manufactured by Hardwood Line Co., Chicago, Ill.

RADAR is destined to save even more ships and planes—and lives—in peace than it did in war. No longer need these be lost in fog or foul weather. Present adaptations of radar can locate them . . . guide them safely to harbor or airport.

In this important work Du Pont polythene plays an indispensable part. The cables that carry radar's ultra-high frequencies must have an insulating material of low electrical losses—which at the same time is flexible at low temperatures. *Du Pont polythene meets both these requirements.*

The demand for Du Pont polythene currently is largely in excess of the supply, but for future product plans it may be to your advantage to know about polythene . . . and the other Du Pont plastics too. All of them have helped manufacturers in many fields to create new products, to make old ones more useful, more salable. Write for information to E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Room 3610, Arlington, New Jersey.

Cable shown made by Anaconda Wire & Cable Company, Hastings-on-Hudson, N. Y.

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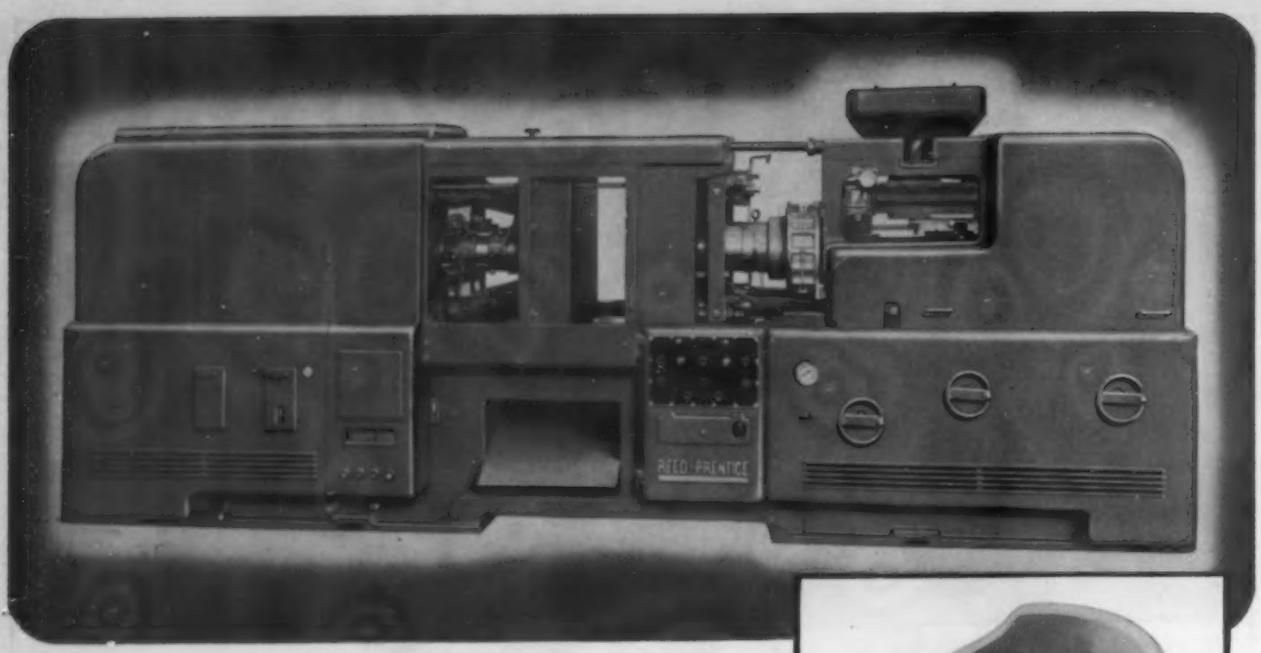
. . . THROUGH CHEMISTRY



Meeting Every INJECTION MOLDING *Requirement!*

For the molder who has production runs varying from small to large cavities, the Reed-Prentice 10H-22 Oz. model plastic injection machine offers absolute versatility.

The plasticizing capacity of the heater is well illustrated by the complete filling of the comparatively thin wall sections of the molds used in making these products.

The Toidy Seat body (a shot weighing over 22 Oz.) is molded from acetate and ethyl cellulose and is produced on a cycle of 30 per hour on a standard 22 Oz. machine by Eclipse Molded Products Co., Milwaukee, for the Hamilton Mfg. Co., Two Rivers, Wisconsin. The 8 Oz. footrest is made from a separate mold.

Another large plastic product, the hair dryer shroud (a 22 Oz. shot) is made by the same molders for the Rilling Corp., Minneapolis, from polystyrene on the 22 Oz. machine on a cycle of approximately 35 per hour.

These are only two of hundreds of plastic products being accurately and economically molded by the Reed-Prentice 10H-22 Oz. model. A complete range of machine sizes is available in 4, 6, 8, 12, 16 and 22 Oz. capacities. For information and descriptive circular write Dept. D.

Toidy seat — molded on Reed-Prentice standard 22 Oz. machine.

Standard 22 Oz. model accurately molds this hair dryer shroud.

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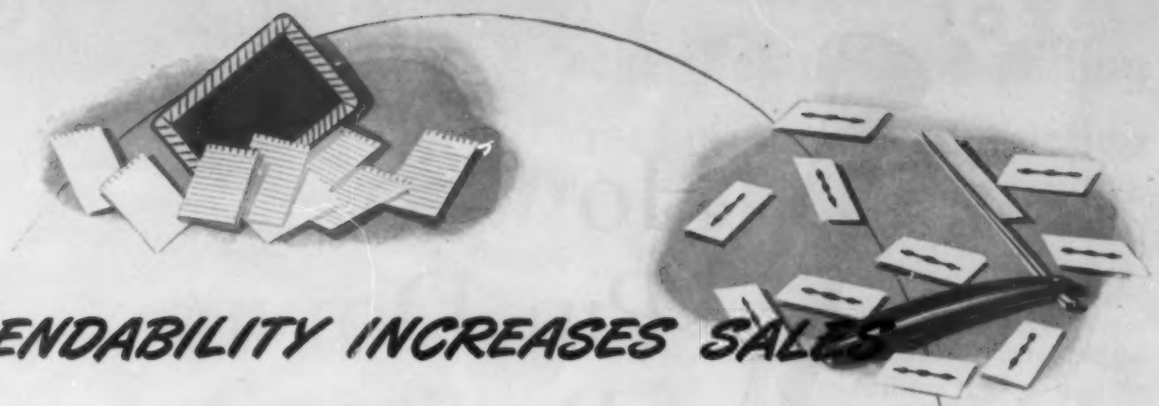


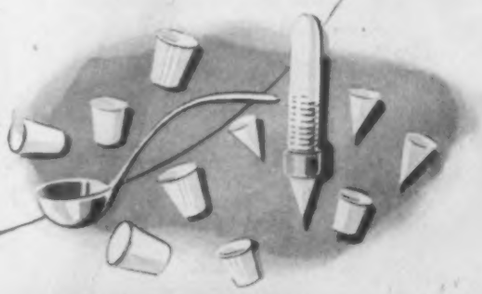
EXPENDABILITY INCREASES SALES

Would your product better meet consumer requirements if it could be "discarded after one using"? Would your sales jump?

The idea of PRODUCT EXPENDABILITY has made possible an advance in penicillin therapy by providing a method for administering a 24-hour dosage in one injection. A special cartridge-type LUMARITH plastic syringe —discarded after one using—is the basis of this new treatment.

The disposable-type syringe offers both medical and economic advantages . . . the one-daily injection replaces the usual eight, and at the same time maintains a steadier curve of therapeutic effectiveness . . . reduces the cost of treatment and minimizes patient discomfort.

The plastic syringe is a notable example of the possibilities of the expendable product. Can you use the *throw-away-after-one-using* principle in your product planning? The Celanese Technical Staff welcomes your inquiries—is prepared to show how the high-speed moldability and all-around production economies of Lumarith recommend this Celanese* plastic for the expendable product. Celanese Plastics Corporation, a division of Celanese Corporation of America, 180 Madison Avenue, New York 16, N. Y., producers of LUMARITH*, FORTICEL*, CELCON†, CELLULOID*, VIMLITE*.



SINGLE INJECTION SYRINGE

Molded—10 to a sprue—from Lumarith (cellulose acetate). The free-flowing characteristics of Lumarith insure a well-locked needle. The snug fit of the protective cap insures needle sterility. Molding cycle is 50 seconds—twenty seconds of which is consumed in placing the needles. Molded by Presque Isle Plastics Company of Erie, Pa., for Becton Dickinson, Rutherford, N. J.

*Reg. U. S. Pat. Off.
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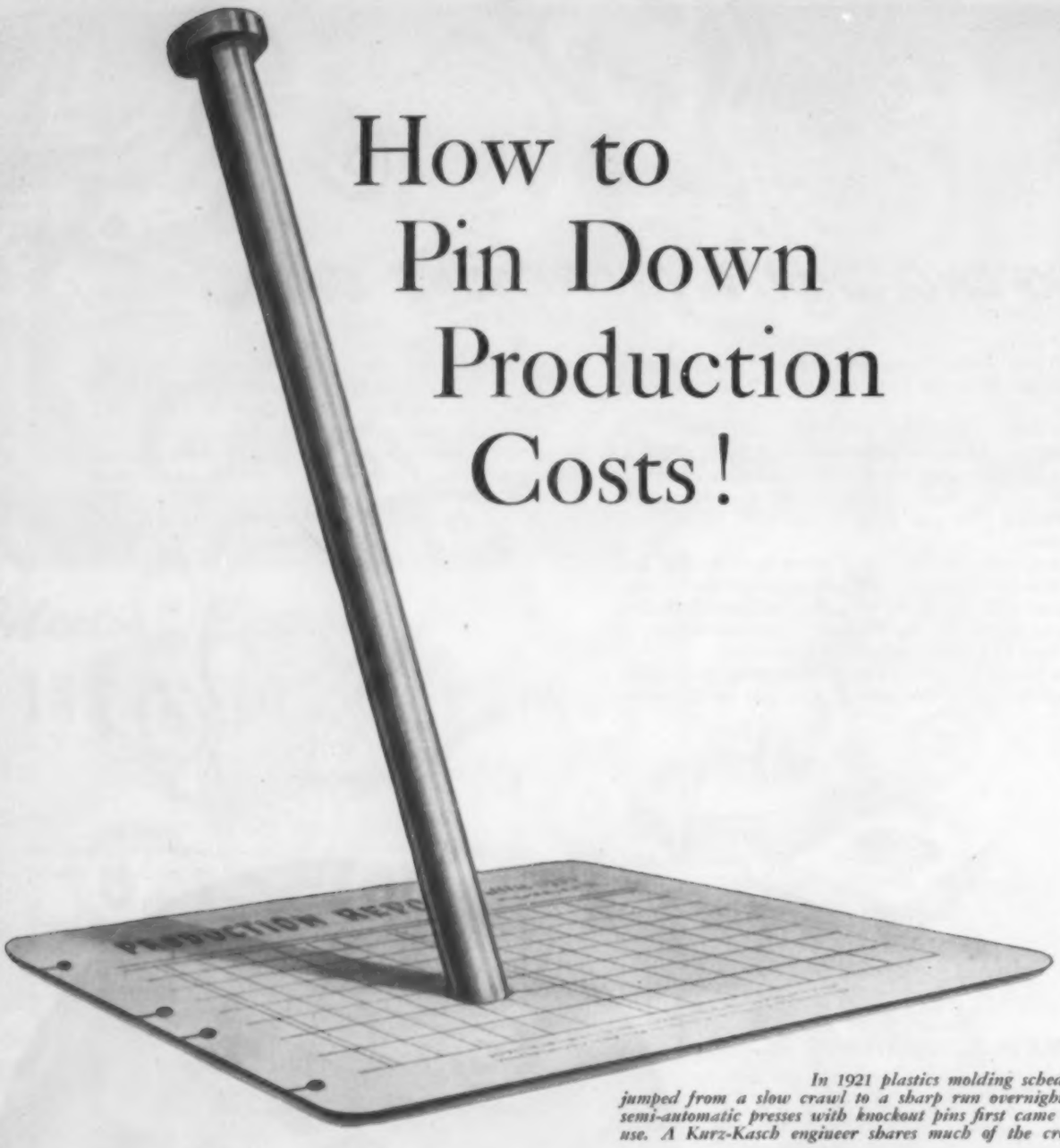
LUMARITH®
A Celanese® Plastic

How to Pin Down Production Costs!



In 1921 plastics molding schedules jumped from a slow crawl to a sharp run overnight, as semi-automatic presses with knockout pins first came into use. A Kurz-Kasch engineer shares much of the credit!

TOMORROW'S improved molding practices will grow out of bright ideas simmering *today* in some progressive molding plant—paying dividends to the customers whose production will benefit before the crowd.

New production ideas have been an *old* Kurz-Kasch habit since the birth of the plastics industry. *See* how they'll benefit you—*send* for your free booklet, "A Businessman's Guide to the Molding of Plastics"—on your business letterhead, please.

Kurz-Kasch

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Planners and Molders in Plastics

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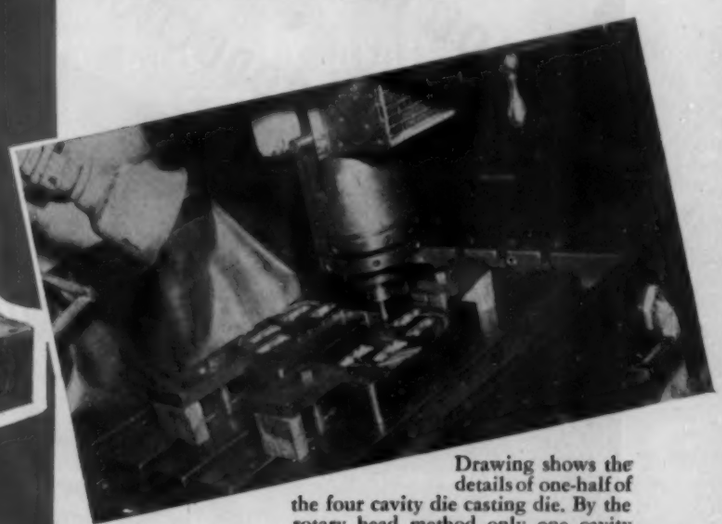
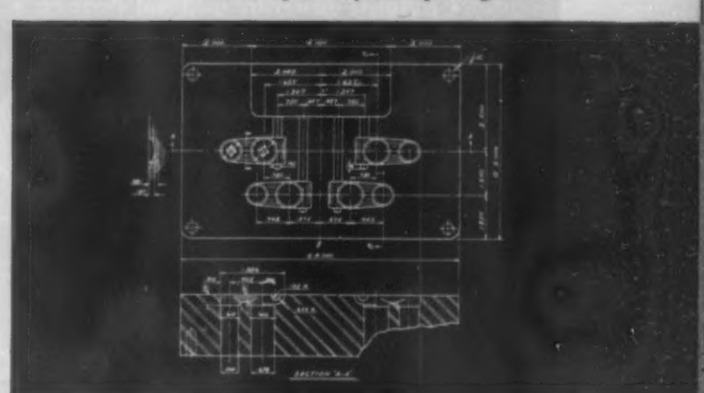
"Our Kearney & Trecker Rotary Head Milling Machine increased our die production at least 75 percent"

The operation below was performed on a Kearney & Trecker Rotary Head Milling Machine at the McGill Mfg. Co., Valparaiso, Indiana. It shows the machining of a die. Both die halves were properly aligned on the machine table to permit finishing the four cavities complete in one setting. It is typical of the precise work done at this plant.

K. S. Laughery, Superintendent says: "Our Kearney & Trecker Rotary Head Milling Machine has increased our die production at least 75 percent. It has enabled us to produce better finishes and a superior quality of work. We could not afford to be without this machine."



Drawing shows the details of one-half of the four cavity die casting die. By the rotary head method only one cavity was laid out and then each operation was repeated by "multiple origination."



DIRECT — ACCURATE — FAST — are the three factors that make the Kearney & Trecker Rotary Head Milling Machine so outstanding for toolroom, experimental, and manufacturing work. DIRECT — because it mills intricate shapes in a single setup, transmitting blueprint dimensions direct to the workpiece without the aid of models or templets. ACCURATE — because there is exact control of all mechanical movements. FAST — because initial preparation and multiple setups are eliminated, reducing non-productive time. The accurate performance of the machine also saves operating time.

Write for further detailed information and Bulletin No. 1002C.

BUILDERS OF MILWAUKEE ROTARY HEAD MILLING MACHINE • MIDGETMILL • SPEEDMILL • FACE MILL GRINDER • AUTOMETRIC BORING MACHINES

4727

Kearney & Trecker
CORPORATION
MILWAUKEE 14, WISCONSIN

Millions of toothbrushes now being produced have handles of Chemaco Ethyl Cellulose—the newest material to be adapted to the purpose. Extremely versatile, Chemaco Ethyl Cellulose offers many advantages: • sparkling, attractive colors; • transparent, translucent and opaque materials • amazing flexural strength and resistance to impact; • dimensional stability to retain bristle anchorage • no chipping during bristling operation; • complete affinity for gold leaf stamping • remarkably low specific gravity (approx. 1.07) • manufacturing economy—a faster molding cycle with more pieces delivered per pound than by any other cellulosic material • durability—(in tests these handles have far outlasted the bristles). Many of these advantages recommend Chemaco Ethyl Cellulose for other types of product. Perhaps it can answer your mass production problems.

Your inquiry will receive prompt attention.

Chemaco Corporation

A subsidiary of Manufacturers Chemical Corporation

Berkeley Heights, N. J.

Branch office in Cleveland

ETHYL CELLULOSE • CELLULOSE ACETATE • POLYSTYRENE

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Whether you need lustrous new packages and glamorous products of high consumer appeal for the retail trade . . . or rugged, economical plastic parts for your machine . . . we can supply the manufacturing know-how and skilled craftsmanship which can speed your work straight through from formative stage to completed product.

A complete plastic service . . . engineering, design and mold-making . . . is available to you "under one roof". We thrive on "tough" problems. Write us yours. A telephone call or letter will bring prompt, personal, expert advice on your plastic problems — without obligation, of course. Write to Dept. M.

Fisher PLASTICS

FISHER PLASTICS CORPORATION

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"Nylon Lines Are Duck Soup for Her Since She Got That Transparent Plastic Folding Chair"

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An interesting Decimal Chart that saves time; gives diameter, area and circumference of circles and surface and volume of spheres for each additional fractional increment (1/64) of diameter. 4-page folder 3-ring punched. Yours upon receipt of request on your company letterhead.

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Imagine the satisfaction of being able to turn over YOUR time-consuming job of designing molded plastic parts to OUR engineers! Get it out of your hair fast — yet with assurance of its satisfactory solution because you're putting it in the hands of men of experience.

Our group will work directly with your men to produce the plastic parts you need. If the part you want can be molded, we'll know how to do it, or we'll research until we do.

What can we do for you?

If it can be Molded, Boonton can Mold it

BMCO

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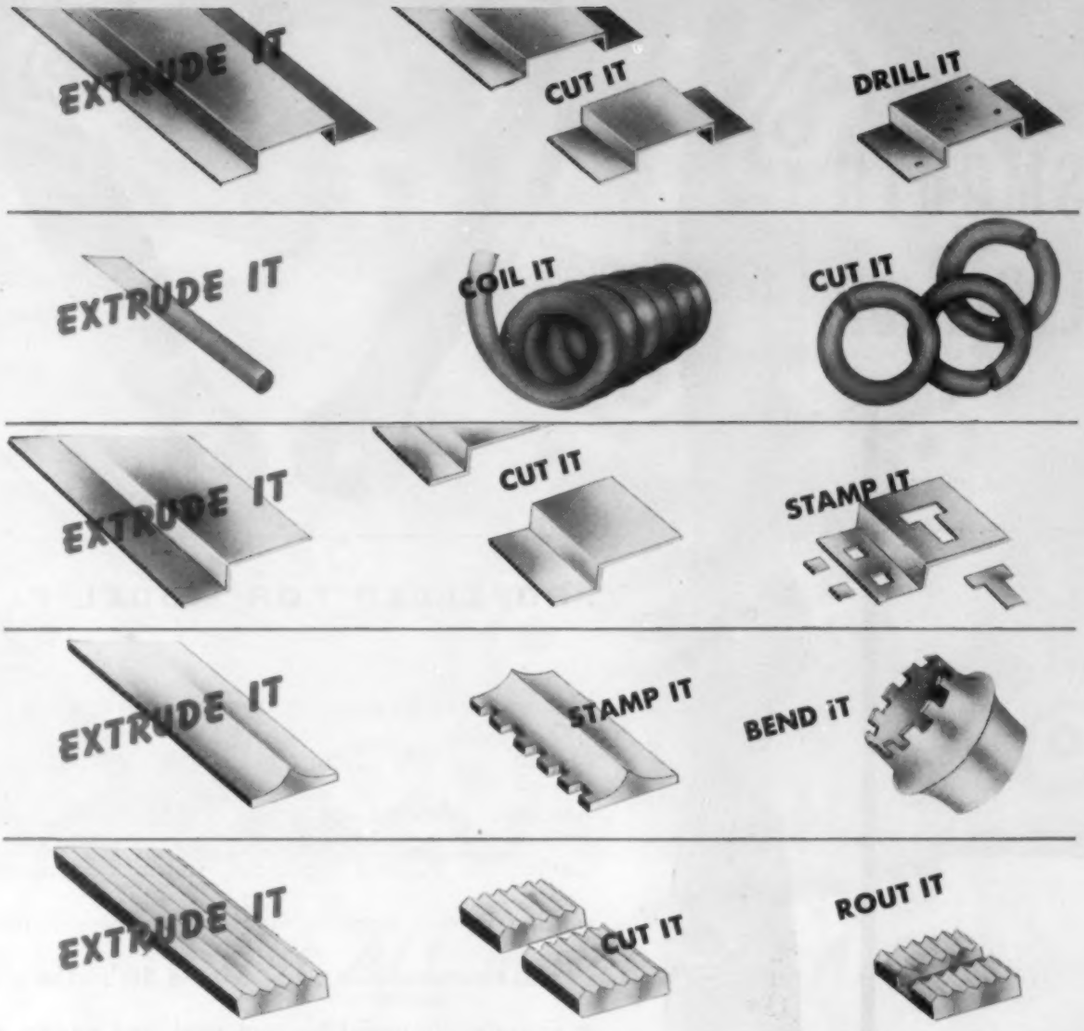

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When you plan your product for production, it pays to plan to *extrude* as many of the plastics parts as possible. Extrusion is a continuous process; you save manufacturing time. Extrusions have a smooth, clean-cut finish; no buffing or polishing. Variety of shapes which can be produced to close tolerances and with uniform physical properties on NRM Extruders is virtually limitless.

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Plastics
MACHINERY DIVISION

A SMOOTH MOLDING JOB

PROPELLER FOR MODEL PLANE

It doesn't take an engineer to appreciate this fine example of Insulation Manufacturing Company's custom injection molding. Molded for Joyce Products, Inc., Rockville Center, N. Y., this ingenious, self-locking propeller is molded in two sections—in a variety of striking colors —and comes in two sizes, 8" and 10". The propeller is scientifically tested for true pitch and perfect dynamic balance.

This propeller is only one example of the kind of custom molding Insulation Manufacturing Company does. Our facilities are open to all industries seeking custom injection or compression molding to fulfill the most rigid specifications.

INSULATION MANUFACTURING COMPANY, INC.

CUSTOM MOLDERS OF PLASTICS FOR INDUSTRY

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...but ALL Molded by AICO

HANDLE

Black general purpose phenolic material was used because it is strong and relatively unaffected by heat. It also has low moisture absorption which is an asset, since the part is exposed to considerable perspiration. The "Greyhound" trade name is an integral part of the handle which cannot be removed or worn off.

CONNECTOR PLUG

Compression molded from heat resistant black phenolic. Material with a high heat distortion point was necessary because of the high temperature encountered at the point of application. Mold costs were eliminated because this part is one of hundreds of stock designs available from the Aico stock mold catalog.

INDICATOR KNOB

Our own Aico cold molding material was used to mold this part because, it too, is subject to intense heat. This material has a very high heat distortion point. A metal insert is molded in the base of the knob —making assembly a simple matter.

Production detail will be greatly simplified if *all* your plastic parts are supplied by one molder. Blueprints can be kept together . . . correspondence limited to one source.

***But,* exceptional care must be exercised in the selection of that molder. The choice of the one method and one material best suited to the requirements of each individual part depends entirely on him. Aico has no "axe to grind" in favor of any one method or material. Our recommendations are completely unbiased.**

Our plant is equipped for all molding methods. We have had 30 years' experience using all plastic materials. In addition, we do not hesitate to suggest the use of a stock mold whenever possible. This saves the cost of making original molds.

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There will be no mystery about plastics, after you have read this book. It illustrates many familiar products that have been adapted to plastics. It shows how to go about adding the advantages of plastics to your products. When writing for your copy—use your letterhead, please.

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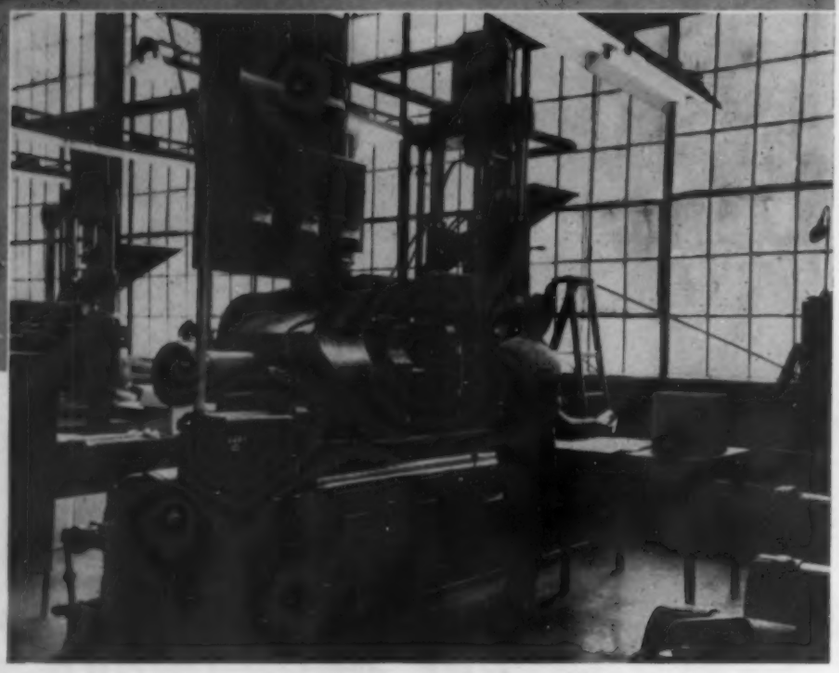
NEW FREEDOM, PA.

SALES OFFICES — CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA

for over 30 years **Aico PRECISION MOLDING** *. . . using all methods . . . all materials*



These exquisite horn buttons, auto dash panels and refrigerator name plates were molded from crystal-clear plastic on a group of LESTER Injection Molding Machines in the Hoosier-Cardinal plant in Evansville, Indiana. All have a high glossy finish — and there are no mold or shrink marks. The machine shown is one of a group of four LESTERS in continual operation.

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The New* LESTER *machines have these exclusive features...

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* ***Dependability***...LESTER users will tell you, "Maintenance is *not* a problem with the new LESTER machines."

* ***Quality***...The Hoosier-Cardinal people who made the parts shown above told us, "Flexibility of control in both injection speed and injection pressure on our LESTER machines is a big factor in maintaining the quality of our unusual products."

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Look at this beautiful, new 13-lb. combination radio-phonograph cabinet, compression-molded of Resinox in just two pieces . . . unthinkable yesterday, entirely practical today!

New Resinox formulations, new molding skills and new equipment make possible this achievement. In addition to size, Resinox offers the manufacturer the beauty and economy of molded-in colors and lustrous finish; light weight; strength . . . plus integrated design, fittings, etc., that might otherwise require special machining and assembly costs.

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If you are thinking of plastics only in terms of relatively small molded pieces, you should hear the latest about Monsanto's versatile thermosetting phenolic plastic, Resinox . . . now going into radio cabinets, complete toilet seats, machine housings, washing machine agitators, auto parts, etc. Details sent you direct. Simply address: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield 2, Mass. In Canada, Monsanto Ltd., Montreal, Toronto, Vancouver.

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WHAT'S YOUR PLASTICS PROBLEM?

THERE is hardly a manufacturer in business today who is not concerned, in one way or another, with plastics.

Perhaps it's some functional item such as a handle or a knob. Or, maybe, it's a decorative merchandiser such as a container. Then again, it may be a housing of some sort. In any case, if it's a question of plastics, bring your problems to Norton.

For more than twenty years Norton has been serving industry on an ever-increasing scale. Now there's scarcely an industry group existing for which Norton does not mold some type of plastic item. Note illustration above.

In addition to the extensive facilities for injection and compression molding which are available at Norton, the customer further benefits from the wealth of successful product development experience which makes up the background of our design engineers . . . *an important "extra".*

So whatever your plastics problem may be, send it along with all the details to Norton Laboratories, Inc. In this way, you can be absolutely sure of competent counsel and immediate action. Norton Laboratories, Inc., Lockport, N. Y. *Sales Offices: 347 Fifth Avenue, New York City; 9 South Clinton Street, Chicago.*

NORTON *Laboratories, Inc.*

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— the Universal Testing Machine for Tension-Compression & Flexure Testing of Plastics

Illustrating a compression test on plastic gears, showing clearly the special fixture for mounting and exerting strain against the gear teeth.

The Olsen Plastiversal in use at Continental-Diamond Fibre Co., Bridgeport, Pa., shown with High Magnification Recorder and Multi-mask Dial.

Photographs courtesy of Continental-Diamond Fibre Company

The Olsen Plastiversal is designed especially for the varied and exacting requirements of the plastics industry. With this compact unit, precision tests can be made in tension, or flexure on film, sheet, or molded specimens. Thick plates, blocks, or other objects can be tested to heavy loads in flexure and compression.

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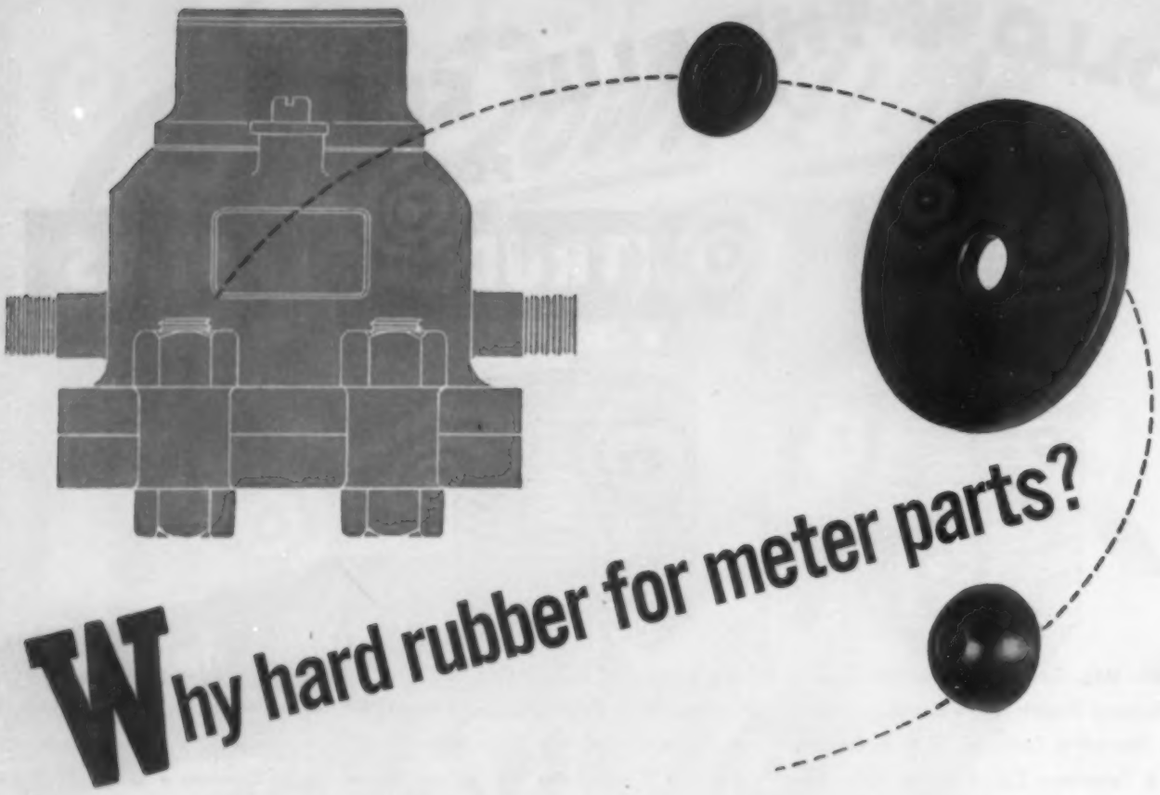
ORIGINATORS OF DRY PROCESS PLASTICS EXTRUSION



Why hard rubber for meter parts?

The reasons so many water meter manufacturers use hard rubber may lead you to the solution of one of your design or production problems

Of all the plastics, hard rubber is the most nearly waterproof. It maintains dimensional stability remarkably well in the presence of moisture and most solvents. In addition, hard rubber is easily machined.

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(or a knife handle? — see our ad in Modern Plastics for July)

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Might be worth exploring.

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Uniform in weave, strength, toughness, resiliency, flexibility and absorptive qualities, Mt. Vernon Extra fabrics assure you more stable laminates in every run. This quality in Mt. Vernon fabrics is the result of spinning and weaving to rigid standards of tolerances which are constantly checked by a broad system of laboratory controls. For fabrics that minimize processing problems and provide maximum uniform quality in laminates, specify Mt. Vernon Extra.

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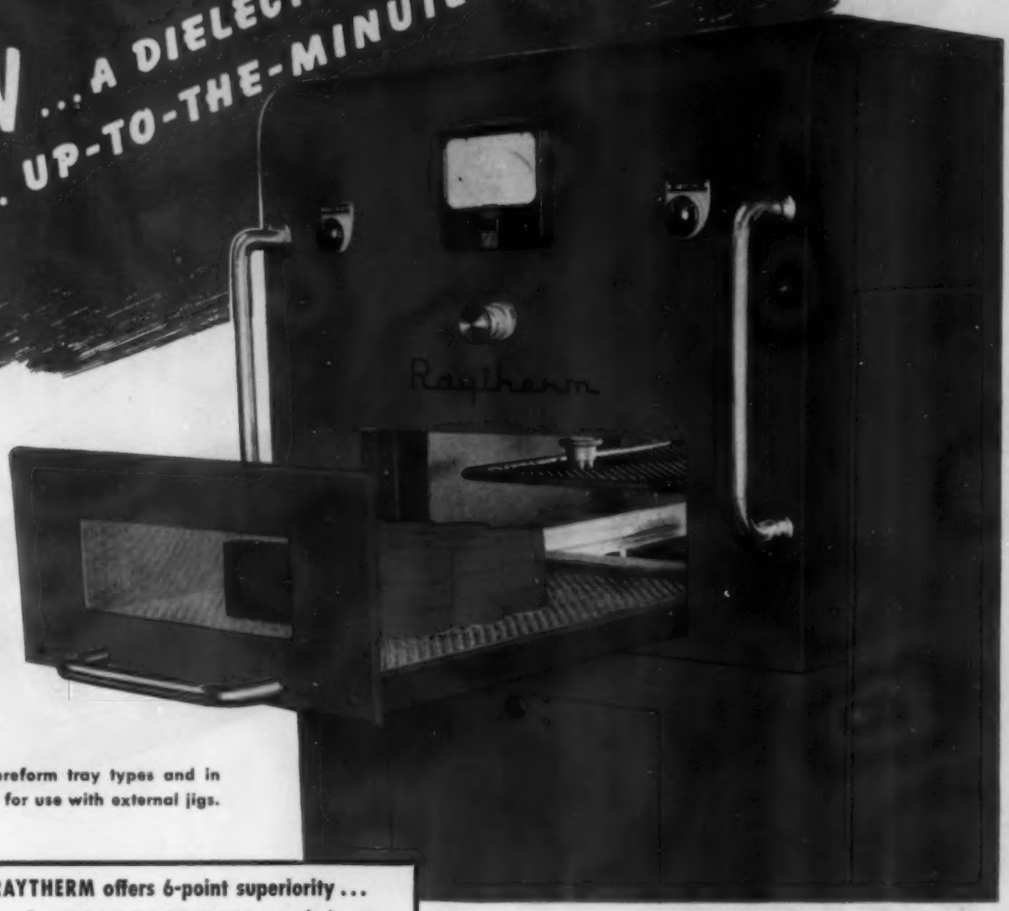

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Save production dollars . . . release valuable space and equipment . . . and reduce handling. Assure fast, efficient pre-heating of preforms, laminating, heat sealing, seal bonding . . . with the new RAYTHEON Raytherm.

This newest of all dielectric heaters is rugged, practical, *modern*. Possesses new and exclusive design features. Discuss your requirements with RAYTHEON application engineers. Find out which operations you can further speed and improve with the new RAYTHEON Raytherm.

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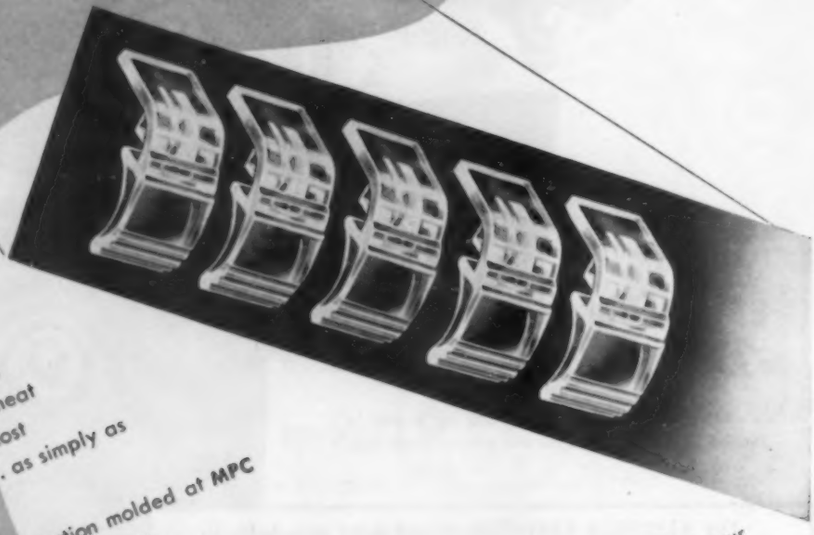
Excellence in Electronics

PLASTIC PUSH-BUTTONS FOR A "HOT NUMBER"



A distinguishing feature of the new Motorola Gasoline Automobile Heater is selective heat control. You select the temperature for utmost comfort by pushing the proper button . . . as simply as tuning a station on a push-button radio.

● A row of five heat-selector buttons, injection molded at **MPC** from crystal-clear plastic, contributes much to the clean, modern styling of the control unit. These push-buttons are designed to be amply rugged. The use of plastics makes them always comfortable to the touch.

Call on us at **MPC** for design or engineering assistance and production "know-how" in the manufacture of your plastic molded parts or products. We have the most advanced compression, injection and transfer molding equipment . . . supplemented by our own large tool room and extensive finishing facilities. Write to MOLDED PRODUCTS CORPORATION, 4535 W. Harrison Street, Chicago 24, Illinois.

PLASTICS DIVISION
MOLDED MPC PRODUCTS
CORPORATION

YOU CAN PUT *this plastic* IN YOUR REFRIGERATOR!

This bright young housewife, of course, is elated with her new refrigerator. And rightly! It's the product of a progressive industry that quickly takes hold of worthwhile new ideas.

Dow is proud to supply that industry with basic materials like Styron, the nation's leading plastic. Styron is used by many top-rate refrigerator manufacturers in ice compartment doors, shelves, door handles and other parts. (That colorful bowl is Styron, too!) Manufacturers know you can put Styron in your refrigerator—and add beauty and utility—because of Styron's brilliance and its ability to withstand everyday use, even at low temperatures. And it doesn't impart taste or odor to food.

Those are only a few reasons why Styron is in demand as a starting point for fine products—from toys and costume jewelry to batteries and automobile parts. Alert manufacturers have learned many reasons (and users of their products are finding out!) why Styron is the name you can *depend* on in plastics.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

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Houston • San Francisco • Los Angeles • Seattle

Dow Plastics include: *Styron, Saran, Saran Film, Ethocel and Ethocel Sheeting*

STYRON

THE NAME YOU CAN DEPEND ON IN PLASTICS

Styron (Dow Polystyrene) is unsurpassed in brilliance and hardness among plastics. These and other qualities recommend it for use in many manufacturing fields. Other Dow plastics: Saran for colorful fabrics that can be cleaned with a damp cloth, non-rusting window screen or corrosion-resistant pipe and tubing; Saran Film and Ethocel Sheeting for better packaging; Ethocel for durable molded products; and materials for coatings and finishes.

DOW PLASTICS

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A NEW CHAPTER IN THE HISTORY OF TEXTILES

Sturdy, colorful fabrics, in a variety of weaves and textures give added sales appeal to upholstery fabrics.

Luggage covered with SARAN resists scuffing and scraping .. keeps its smart appearance thru years of service.

Shoes and handbags that can be cleaned with a damp cloth, have been fashioned of SARAN by leading designers.

Auto seat covers woven of SARAN resist hard usage, won't sag or bulge .. defy dirt and grease!

THERE'S solid comfort in that chair, but there's more than meets the eye in the SARAN fabric that covers it.

Extruded by National as a tough, flexible monofilament, SARAN is being woven into wear-resistant fabrics of breath-taking beauty. SARAN won't absorb dirt and grease. It is not affected by acids, alcohol and most other chemicals.

Wide and ever-growing markets are being created for numerous products with the aid of this "magic thread".

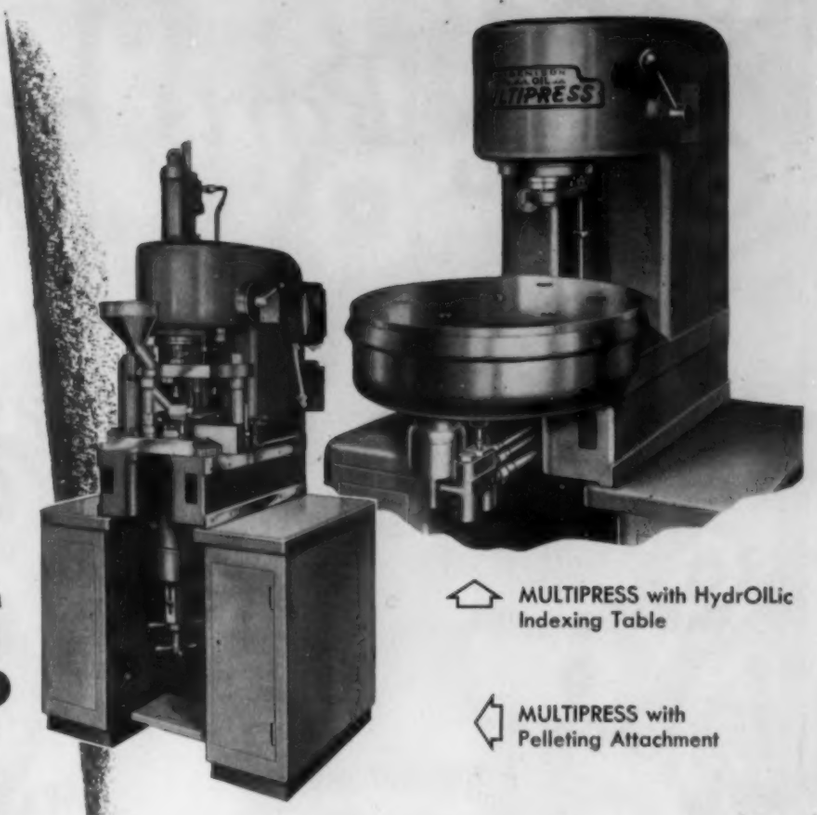
▶ National's extensive technical facilities are available for the study of your product. Write for specific information and samples of SARAN BY NATIONAL.

TRADE MARK REG. U.S. PAT. OFF.

The NATIONAL Plastic Products Company

ODENTON • MARYLAND

Blanking
Forming
Pelleting
Shearing
Marking
Assembling
with MULTIPRESS



MULTIPRESS with HydrOlLic Indexing Table

MULTIPRESS with Pelleting Attachment

Basic 4-Ton MULTIPRESS (Also 6 & 8 ton capacities)

On scores of jobs like these—and many others—MULTIPRESS users continue to report higher production, increased efficiency and better results.

The reason: remarkable operating flexibility has been built into the highly compact, fully self-contained *basic* MULTIPRESS—and its flexibility has been further multiplied by an unusually wide range of standard MULTIPRESS controls, toolings and accessories.

In addition, Denison research engineers work constantly to find better ways to apply MULTIPRESS advantages to specific operations of every kind.

MULTIPRESS offers a choice of 4, 6, or 8-ton units . . . seven different models . . . manual or automatic controls . . . accessory benches, work-table extensions, side shelves and bolster plates . . . attachments for indexing, pelleting, foil marking, etc. . . . toolings for almost any need. Write for full details. The Denison Engineering Company, 1176 Dublin Road, Columbus 16, Ohio.

HydrOlLics INDUSTRY'S RIGHT HAND

DENISON EQUIPMENT for APPLIED HydrOlLics

Plastic Parts

CONTAINERS AND CLOSURES

TOYS AND SPECIALTIES

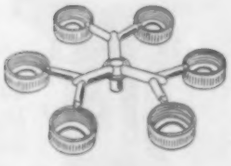
MISCELLANEOUS INDUSTRIAL

OF EVERY DESCRIPTION

PLASTICS St. Louis

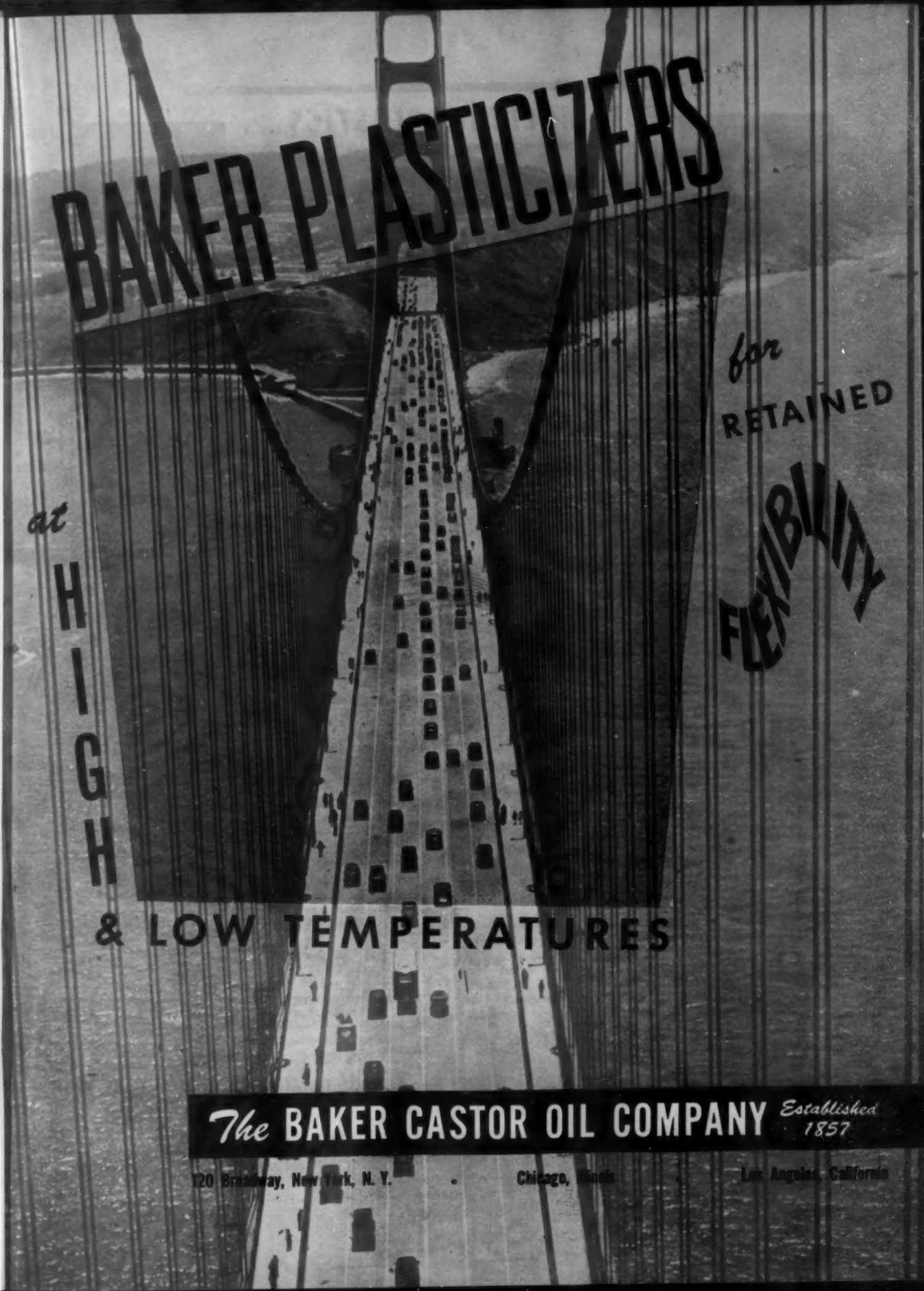
INJECTION MOULDING
EXTRUSION MOULDING
PLASTIC FABRICATION
ENGINEERING COUNSEL

Complete Mould and Tool Shop



ST. LOUIS PLASTIC MOULDING CO.

SAINT LOUIS 8, MISSOURI


BAKER PLASTICIZERS
for
RETAINED
FLEXIBILITY
at
HIGH
& LOW TEMPERATURES
The BAKER CASTOR OIL COMPANY
Established 1857
120 Broadway, New York, N. Y.
Chicago, Illinois
Los Angeles, California

FOR MOLDING PLASTICS...

DISSTON MOLD STEELS

Manufactured to meet your individual needs

Whatever your plastics mold requirements, you are certain to find among these three specialized Disston Mold Steels one that will meet your needs exactly.

FOR DIFFICULT SHAPES AND SHORT RUNS

PLASTIRON . . . a low carbon steel that is easy to work, withstands extreme hobbing, and is exceptionally well suited for intricate forms.

FOR GENERAL SERVICE AND MEDIUM RUNS

PLASTALLOY . . . a low carbon steel having the right amount of chrome and nickel to assure great core strength and long wear, yet permit easy hobbing.

FOR HARD SERVICE AND LONG RUNS

PLASTIKUT . . . a "cut mold" steel for maximum core and case strength. Must be machined instead of hobbed, but because it stands up extra long in service, PLASTIKUT is very economical.

ALL PROVIDE THESE ESSENTIALS

Each of these Disston Mold Steels is composed of carefully selected raw materials and produced in Disston electric furnaces. Modern steel practice keeps every process under rigid control. Each is melted and hot-worked with great care . . . is carefully inspected to assure freedom from porosity and inclusions . . . is uniformly sound, carburizes evenly, and produces unusually smooth cavities.

● If you have a special mold or hob problem, let Disston engineers and metallurgists help you solve it. You may consult them freely, without charge or obligation . . . and in confidence.

Write for Folder Contains much useful information which may help you get best results in your use of mold and hob steels.

STEEL . . . Everybody who wants to obtain steel can help himself to get it by immediately starting scrap into the channels that serve steel mills.

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for

"sales-swinging"

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A. C. Gilbert miniature railroad cars molded of Fibestos, cellulose acetate.

USE MONSANTO PLASTICS

Faithful, down to the last rivet head...

This model American Flyer railroad coach by A. C. Gilbert Mfg. Co. demonstrates how beautifully you can reproduce the most intricate designs and surface detail... with Monsanto Plastics.

With molded plastics you get materials and methods that provide mass production of third dimension detail that is unmatched in perfection or economy by metal stampings, die casting, forging... or machining. (Remember, you pay for designing skill in plastic moldings just once... in the original die.)

Such clean fidelity is more than a technical achievement... it's a proved *sales-producer* ... in toys, personal accessories, writing instruments, art objects, premiums of all kinds.

Lustron and Fibestos, Monsanto's injection molding plastics, offer you the ability to take real punishment, a full range of beautiful colors, and genuine economy. Other Monsanto Plastics offering this same faithful reproduction in combination with other properties are also available. Complete data on request: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield 2, Massachusetts. In Canada, Monsanto Ltd., Montreal, Toronto, Vancouver.

MONSANTO PLASTICS
SERVING INDUSTRY WHICH SERVES MANKIND

The broad and versatile Family of Monsanto Plastics includes: Lustron* polystyrenes • Cerex* heat resistant thermoplastics Vinyl acetals • Nitron* cellulose nitrates Fibestos* cellulose acetates • Thalid* for impression molding • Resinox* phenolics • Resimene* melamines. Forms in which they are supplied include: Sheets • Rods • Tubes • Molding compounds • Industrial resins • Coating compounds • Vuepak* rigid, transparent packaging materials.

*Reg. U. S. Pat. Off.

Actual X-rays taken in the Watertown laboratory of parts molded for Frigidaire and Pass and Seymour.

AT Watertown, this is a daily occurrence—taking pictures, we mean. Every product "MOLDED BY WATERTOWN" is put through that final test, the X-ray. This enables us to be sure that your molded parts are properly cured; that inserts are solidly imbedded; in short—that your product is "molded right".

We maintain complete laboratory facilities . . . Impact and Tensile strength testing equipment—special ovens—blending machines. Each individual product receives the full benefit of this complete service.

• THE WATERTOWN MANUFACTURING COMPANY, WATERTOWN, CONNECTICUT

Offices—New York, Cleveland, Detroit, Chicago, Milwaukee, San Francisco

Watertown

A NAME AS OLD AS THE PLASTICS INDUSTRY

Not only new and better products, but new and more efficient processes and machines with which to manufacture them are being developed to successfully meet today's growing competition in plastics.

ADAMSON UNITED
Multiple Roll
PLASTIC FILM & FABRIC COATING CALENDERS

. . . are becoming the accepted method for the production of accurate, uniform gauge film at high rates of speed. The product, from specially treated roll surfaces, meets the most exacting standards.

We design and build not only the Calenders, but also special Mills for preparing the stock, and the handling equipment for the finished sheet or film.

Our staff of highly trained engineers are prepared to lay out and supply the equipment for your entire process.

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SUBSIDIARY OF UNITED ENGINEERING AND FOUNDRY COMPANY
Plants at: PITTSBURGH · VANDERGRIFT · NEW CASTLE · YOUNGSTOWN · CANTON
The World's Largest Designers and Makers of Rolls and Rolling Mill Equipment.

This booklet belongs on the desk of every designer, engineer, production chief and purchasing agent in plastics. Send for it.

PLASTICS THAT GLOW IN THE DARK . . . MEAN SALES THAT GROW IN THE DAY!

VIOLITE*

LUMINESCENT PHOSPHORESCENT FLUORESCENT PIGMENTS

Plastic products that *glow in the dark* have tremendous sales appeal. This has been proved time and again with dials, knobs, signs, markers, wall-plates, tools, radios, toys, novelties, etc. There may be many items you are now manufacturing, or planning to manufacture, that will benefit by this simple improvement. And it *is* simple! Merely specify the addition of VIOLITE Phosphorescent or Fluorescent Pigments when ordering your plastic molding powders. If you are not completely familiar with the many possibilities offered by VIOLITE send for this free booklet today.

WHEN ORDERING MOLDING POWDER

SPECIFY *VIOLITE* . . .

You need no extra equipment . . . your unit production cost is not appreciably increased . . . you need not alter your production methods . . . our technical experts will gladly advise you how VIOLITE can be used in your own products.

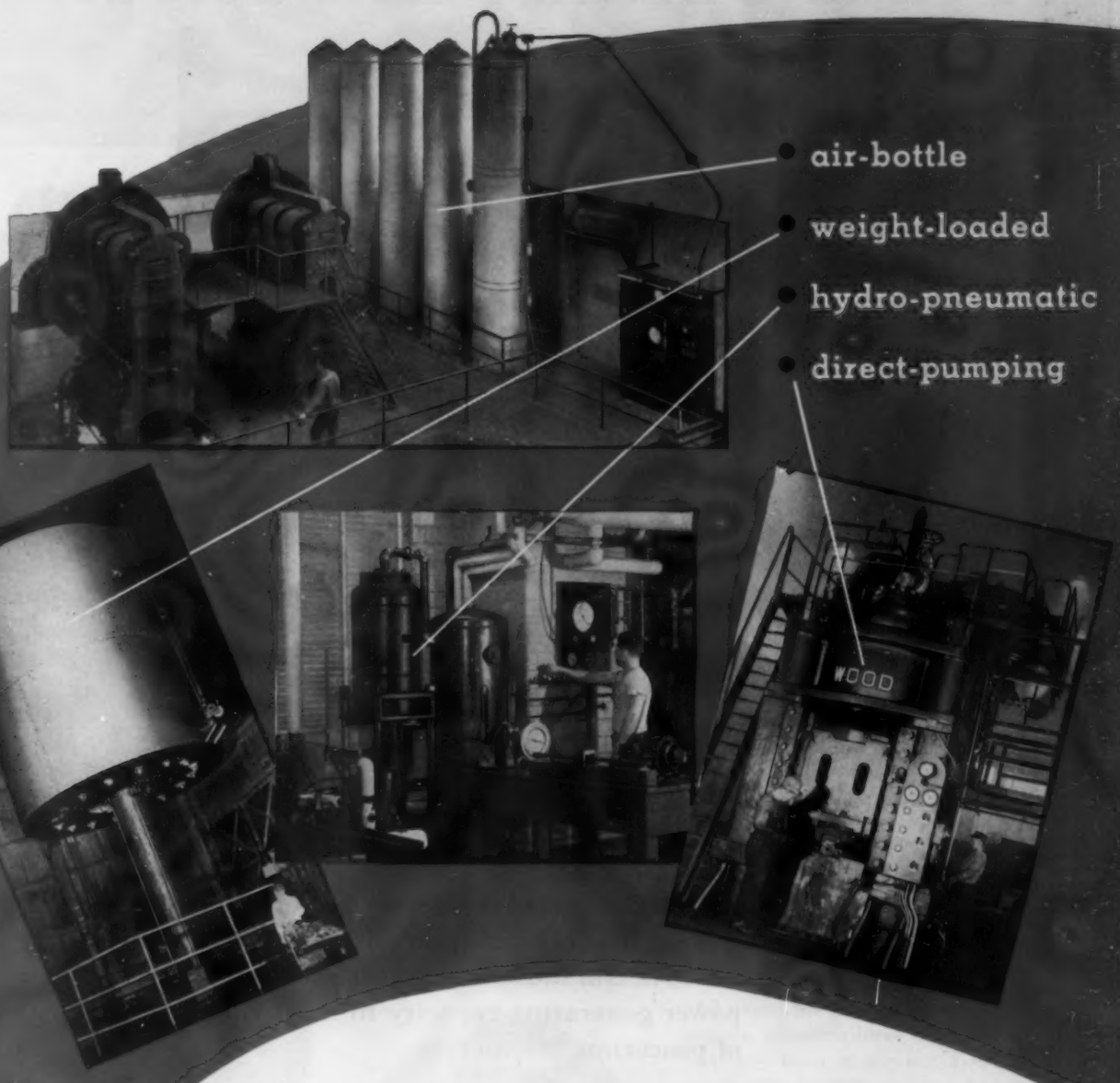
Sun CHEMICAL CORPORATION

VIOLITE
LUMINESCENT PIGMENTS
PHOSPHORESCENT • FLUORESCENT

RHODE ISLAND LABORATORIES, INC.
AN AFFILIATE OF SUN CHEMICAL CORP.
100 PULASKI STREET, WEST WARWICK, R. I.

Reg. U. S. Pat. Off.

which hydraulic power system is <u>best</u> for you?



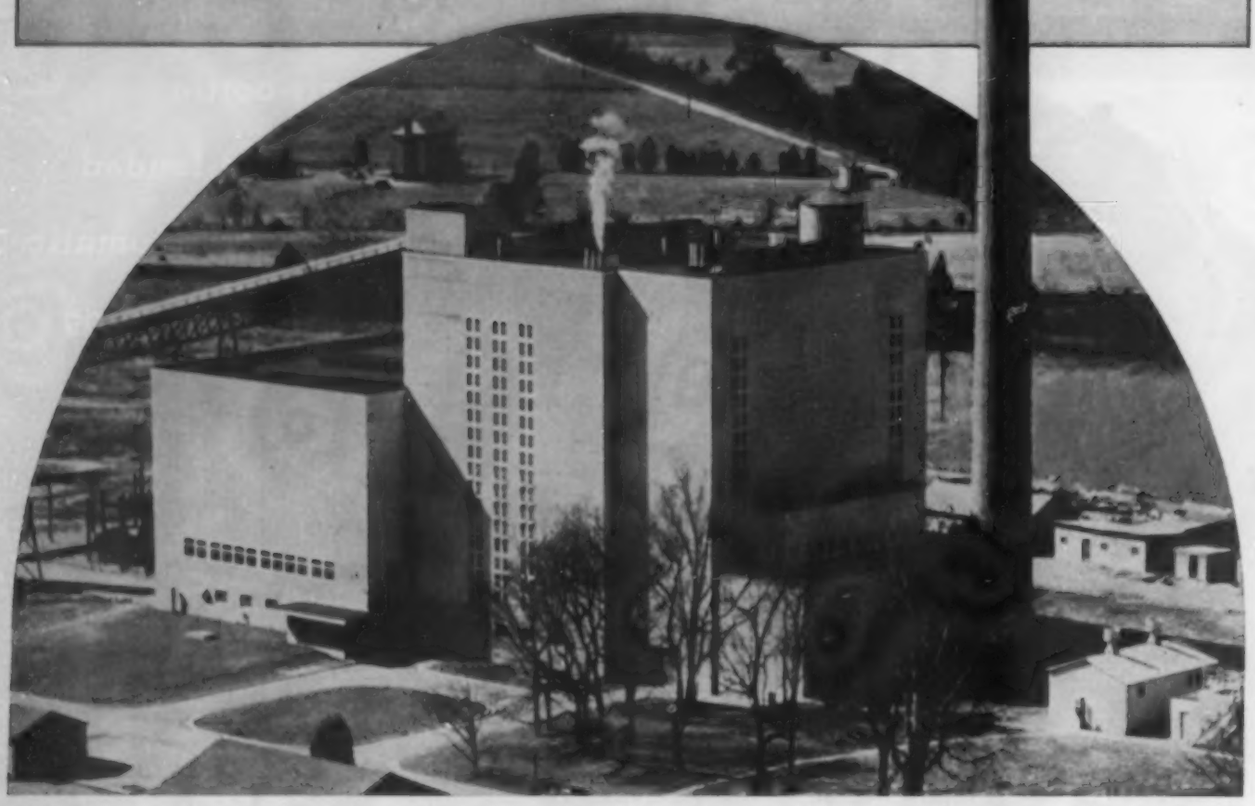
There is no one best hydraulic power system for all applications. But whatever your requirements, you can be sure of getting unbiased recommendations regarding them from Wood engineers, regardless of the size or service of the presses you operate, whether it be one or a hundred. This, because R. D. Wood designs and builds not only pressure-storing accumulator systems, but also furnishes all types of direct-pumping units. In each case our engineers recommend the type of equipment best suited to your individual needs, rather than endeavor to sell you some particular type of system. Their experience can prove highly valuable to you. Prompt attention is given all inquiries. R. D. Wood Company, Public Ledger Bldg., Independence Square, Philadelphia 5, Pa.

HYDRAULIC PRESSES AND VALVES FOR EVERY PURPOSE · ACCUMULATORS · ALLEVIATORS · INTENSIFIERS

R. D. Wood Company

EST. 1803

TURNING DEMAND INTO SUPPLY



Chesterfield Station, Virginia Electric & Power Company, near Richmond, designed and constructed by Stone & Webster Engineering Corporation. Another new power plant for this client is now in the design stage.

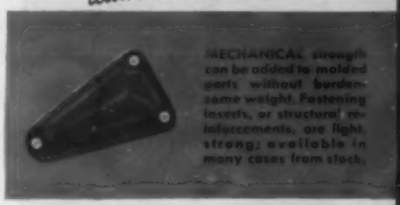
Because of the necessary curtailment of normal power plant construction during the War, the nation's utilities and industrial plants must now increase their power generating capacity to meet the growing needs of peacetime production.

New steam and electric generating facilities and plant extensions, using turbine units ranging from 1,500 to 80,000 KW and boilers ranging from 20,000 to 650,000 pounds of steam per hour, now on the design boards of Stone & Webster Engineering Corporation, will have a total capacity of 673,500 KW and 10,300,000 pounds of steam per hour.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

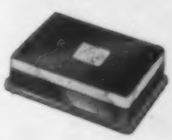
Look what Aluminum-Plastics teamwork can do!



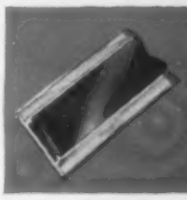
MECHANICAL strength can be added to molded parts without burdensome weight. Fastening inserts, or structural reinforcements, are light, strong; available in many cases from stock.

ELECTRICAL conductivity of aluminum is high. Perhaps you're thinking about a molded plastic electrical part where aluminum inserts provide the necessary conductivity. They're strong, too!

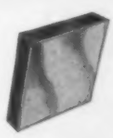
THERMAL properties of aluminum are excellent. Let's say you're designing a plastic product which must be air-cooled. You might use aluminum discs, molded in, as above.



DECORATIVE values of aluminum are a long story in themselves. Use it plain, or with frosty or mirrorlike Alumilite or colored finish (patented process). Remember, it's light!



EXTRUSIONS of plastic combined with extrusions of aluminum? Why not? One supplements the other, in beauty and strength. Alcoa Aluminum is available in many stock shapes.



LAMINATED plastics can be faced with aluminum sheet for a new idea in modern materials. Or, why not inset Alcoa Aluminum decorations in your dark laminates? Attractive!

FORMED plastic sheets team up well with Alcoa Aluminum, as in this navigator's dome. The whole assembly is light, strong, easy to mount. Is there a household idea here?

CHEMICAL properties of aluminum supplement those you like to stress in plastics. Can it help you in products for textile, process, petroleum, pharmaceutical, food industries?

No, you can't take an insert's temperature. It isn't that simple. But you don't need a thermometer to tell when "chills" or "fever" set in as the molding cools. Cracks in the molded article, or looseness of the insert, will show up, now or later.

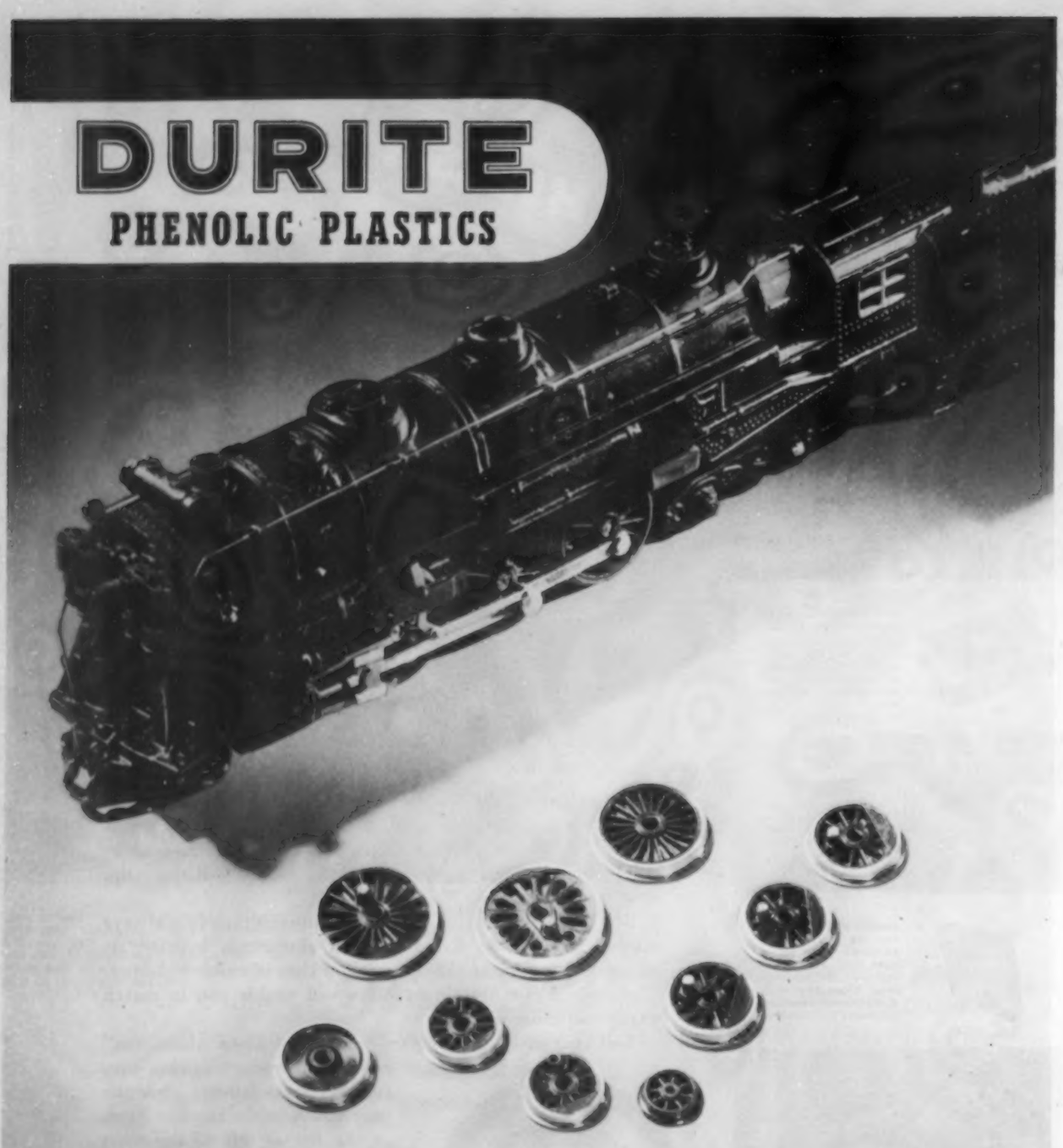
But the heat behavior of Alcoa Aluminum inserts is always normal. No "chills & fever" with aluminum, because its expansion coefficient closely parallels that of molded plastics. The right Alcoa Aluminum Alloy will enable you to match expansion closely.

Tell your insert supplier to "make it of Alcoa Aluminum" and avoid production slow-ups, rejects, stress failures after the part has been in service. Look at the list at left to see what aluminum-plastic teamwork can do! ALUMINUM COMPANY OF AMERICA, 2175 Gulf Building, Pittsburgh 19, Pennsylvania. Sales offices in principal cities.

ALCOA FIRST IN ALUMINUM

IN EVERY COMMERCIAL FORM

DURITE
PHENOLIC PLASTICS



MOLDING COMPOUNDS

For the high accuracy and close tolerances required in molding HO gauge model railroad equipment, Castor Plastics, Philadelphia 24, Penna., use low-shrinkage Durite General Purpose Molding Compounds. Other Durite Compounds are available for *your* special molding applications. Write for complete information.

DURITE PLASTICS INCORPORATED • 5000 Summerdale Ave. • Philadelphia 24, Pa.

Unbreakable Plexiglas and Lucite mirrors for cosmetic items

Colored metallized acetate sheets and rolls for sequins, packaging and decorative uses

Metallic finishing of jewelery, ecclesiastical items, toys, etc.

Metallizing glass and ceramic bottles and caps in gold and silver

Metallizing buttons and novelties in gold, silver and antique

Flexmir INC.

Unbreakable Plexiglas and Lucite mirrors for furniture, building and automotive industries

Mirrorized Plexiglas and Lucite in colors for fabricating gift novelties, lamps, display fixtures, switch plates, etc.

Brilliant Metallic Finishes...

(ALL COLORS INCLUDING GOLD AND SILVER)

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Flexmir INC.

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AFFILIATED COMPANIES: PLASTICS FINISHING CO., INC., FLEXMIR DISPLAY CO., INC. METALLIC PLASTICS CO., INC.

Santay

SYMBOL OF PRECISION CRAFTSMANSHIP

THE HEART AND BRAIN OF THE *ZENITH RECORD CHANGER*

INFINITELY complex yet simple in appearance, the sound pickup housing of the Zenith "Cobra" is held to minute tolerances of plus .001 minus .000. As smooth and gleaming as black velvet are the components that make up this most talked of record changer. Housing and cover of black polystyrene—discriminator knob of red tenite—socket of black lucite and tongue housing of red lustron—all combine to give the utmost in luxurious appearance and versatility of injection molded parts by Santay.

We, at Santay, apply the best of our brains to all parts designed—engineered and molded in our plant. We also know that if the heart is not in the work it cannot be wholly successful. The heart and brain of the Zenith Record Changer have proved themselves out. Let us prove the heart and brain of Santay Corporation to you by better Injection Molded parts.

INJECTION MOLDING AND METAL STAMPING • ELECTRO-MECHANICAL ASSEMBLIES

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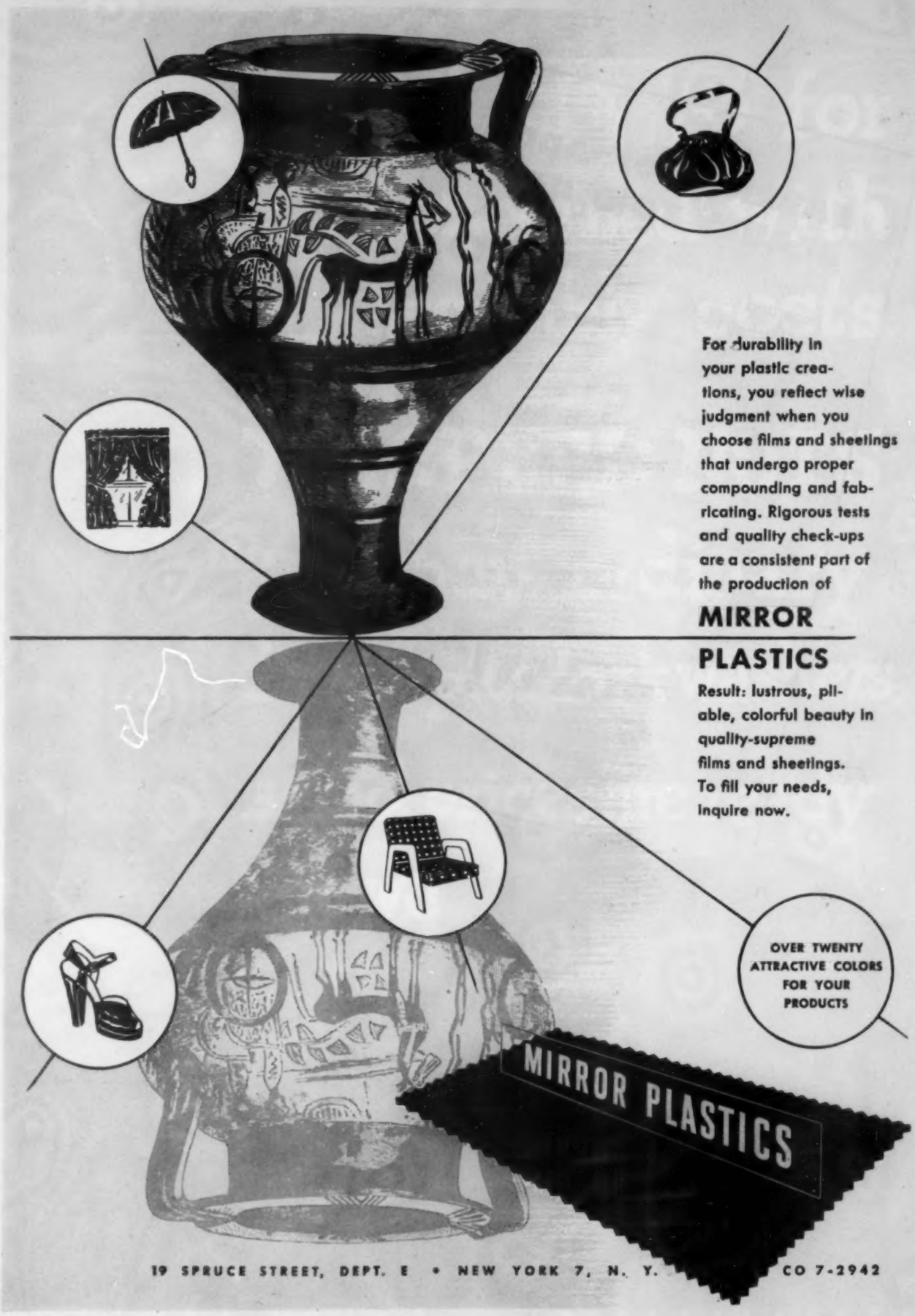
For durability in your plastic creations, you reflect wise judgment when you choose films and sheetings that undergo proper compounding and fabricating. Rigorous tests and quality check-ups are a consistent part of the production of
MIRROR PLASTICS
Result: lustrous, pliable, colorful beauty in quality-supreme films and sheetings. To fill your needs, inquire now.
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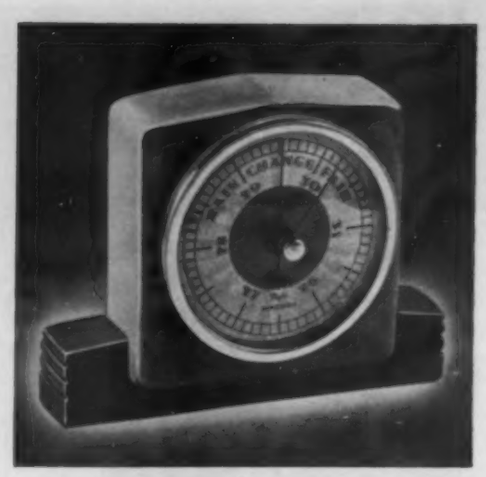
Taylor Instrument Companies' Baroguide base and case, The Turner & Seymour Mfg. Co. kitchen tool handles, and Emerson radio cabinets are striking examples, among many others, of the greater sales appeal of our plastic fabrication. You, too, may have a product which can be skillfully treated to provide similar benefits. Our greatly enlarged and modernized plant offers greater fabricating facilities than ever before. A new conveyor system, new controlled precision mechanisms, and close, expert supervision promote efficiency and allow for greater economy. Our engineers and designers will gladly submit recommendations.

PLASTIC
Turning Co. Inc.
LEOMINSTER, MASS.



Here's REAL NEWS for everyone concerned with reducing assembly costs.

"C7000" SPEED NUTS cost less than ordinary threaded nuts plus lockwashers.

Samples and prices are ready to go-we're waiting for your request.

THESE NEW C7000 self-locking, flat type SPEED NUTS are made in 10 standard sizes for machine screws and sheet metal screws

TINNERMAN PRODUCTS, INC. • 2048 FULTON ROAD • CLEVELAND 13, OHIO

Speed Nuts

MORE THAN 3000 SHAPES AND SIZES

FASTEST THING IN FASTENINGS

THE THERMALL CHAMP

Heats 6 Pounds (96 ozs.) in ONE MINUTE

That's Performance in Preheating Equipment

Whenever you see the THERMALL Diamond on an HF Heating Unit, you can bet your last dollar on the *utmost in performance.*

We'll gladly give you technical and engineering data about every size THERMALL Unit. Users say that we are conservative in our power ratings. They tell us that THERMALL HF Heating Units consistently deliver more than rated power; preheat faster than we claim.

Time after time, users have said they were "amazed at THERMALL *performance.*"

If you have a pre-heating or molding problem of any kind and want technical advice or assistance—write us. We will assist you by assigning one of our technical representatives to your problem without obligation.

When you want a job done day in—day out, remember that

THERMALL *means* PERFORMANCE

The **THERMALL CHAMP** occupies only 20 x 30 inches of your floor space. Heats 96 ounces compound to molding temperature in 1 minute. Completely portable.

Bulletin M gives specifications and details of all THERMALL HF Units. It's free, on request.

W. T. LA ROSE & ASSOCIATES

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Representatives in All Principal Cities

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TO ATTAIN excellence in plastic molding, many steps—each an essential part of the whole process—must be followed through accurately and thoroughly.
Every step of the way—designing, mold making, molding, and finishing—calls for the highest skill and experience, plus the proper plant facilities for efficient production. Combined, these operations can result in quality molding... plastics that "measure up" in performance, appearance and cost.
MACK experience and proven methods, plus three completely equipped plants, offer plastic molding that qualifies. Your inquiries are solicited; address Mack Molding Company, Inc., 100 Main Street, Wayne, N. J.
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MACK PLANT AT WATERLOO, P. Q., CANADA
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Do you have a product you'd like to convert into PLASTIC

OUR ORGANIZATION WILL WELCOME A CHALLENGE TO SOLVE DIFFICULT PROBLEMS IN PRECISION

CUSTOM MOLDING

We invite you
to use the facilities of the
INTERNATIONAL PLASTIC HARMONICA CORP.
makers of the famous MAGNUS
all-plastic harmonica

INTERNATIONAL PLASTIC HARMONICA CORPORATION • 44 DICKERSON STREET • NEWARK 4, N. J.

IF YOU HAVE A PLASTIC PRODUCT TO SELL IN THE FOREIGN MARKET...

The resourcefulness of this export division is reflected in the calibre of men responsible for its success

F. H. MAGNUS · President

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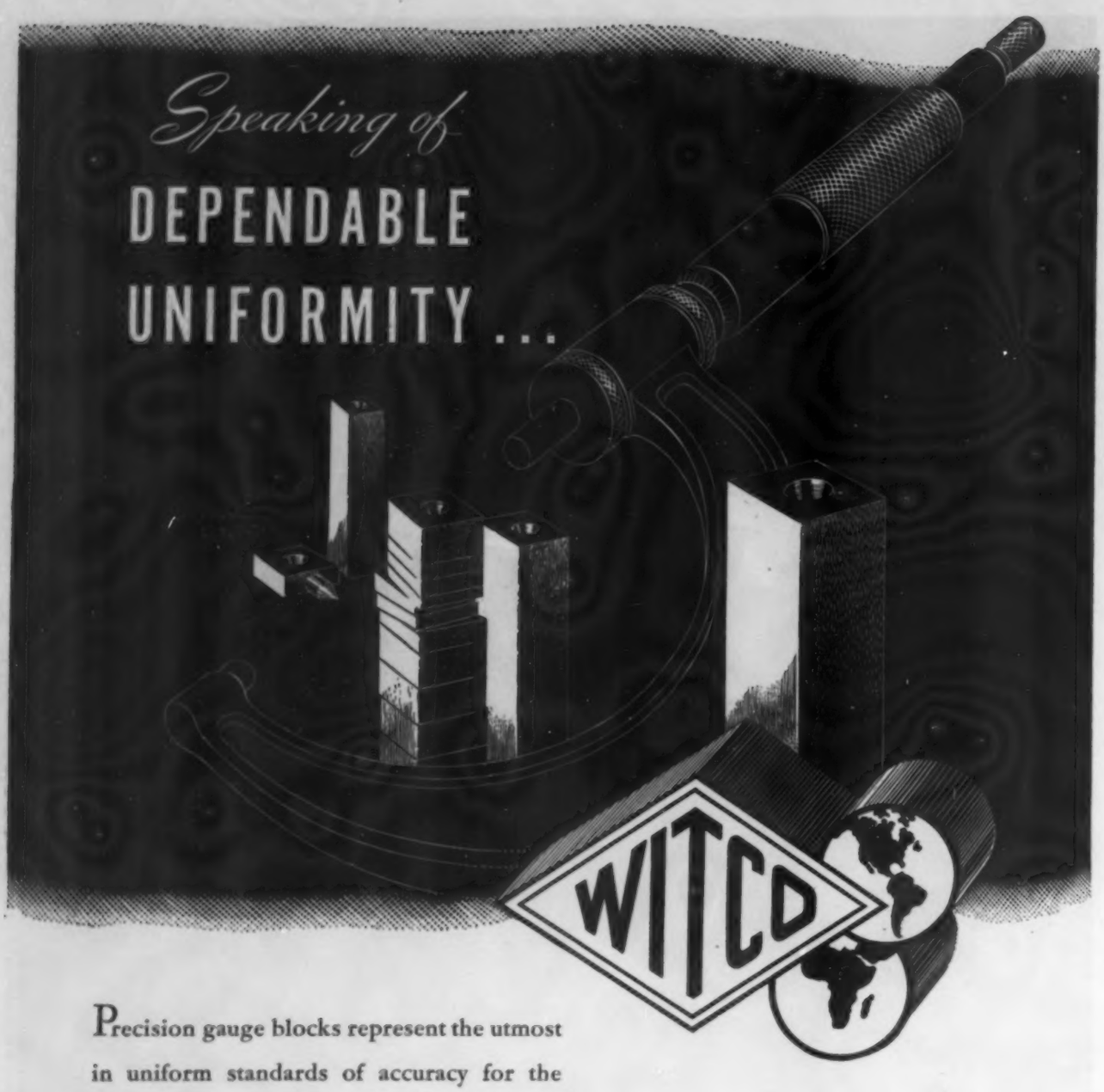

Precision gauge blocks represent the utmost in uniform standards of accuracy for the metal-working industries. And just as definitely the Witco trademark signifies absolutely dependable uniformity of products for industries devoted to plastics, rubber, paint, paper, ink, steel-fabrication, cosmetics and drugs, ceramics, leather.

WITCO CHEMICAL PRODUCTS FOR THE PLASTICS INDUSTRY
DRY COLORS • WITCARB STEARATES • CARBON BLACKS

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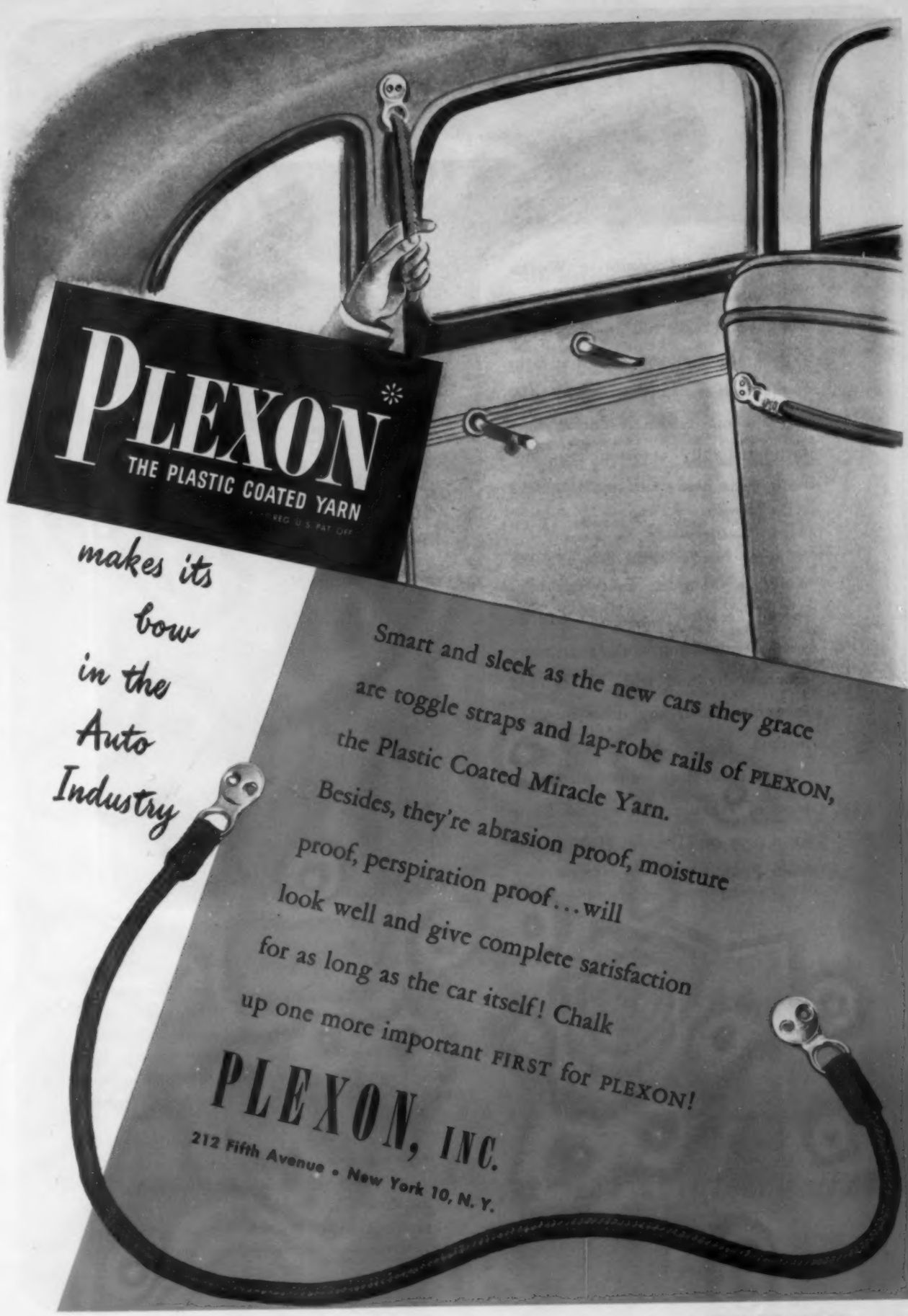
SAN FRANCISCO • AKRON • LONDON AND MANCHESTER, ENGLAND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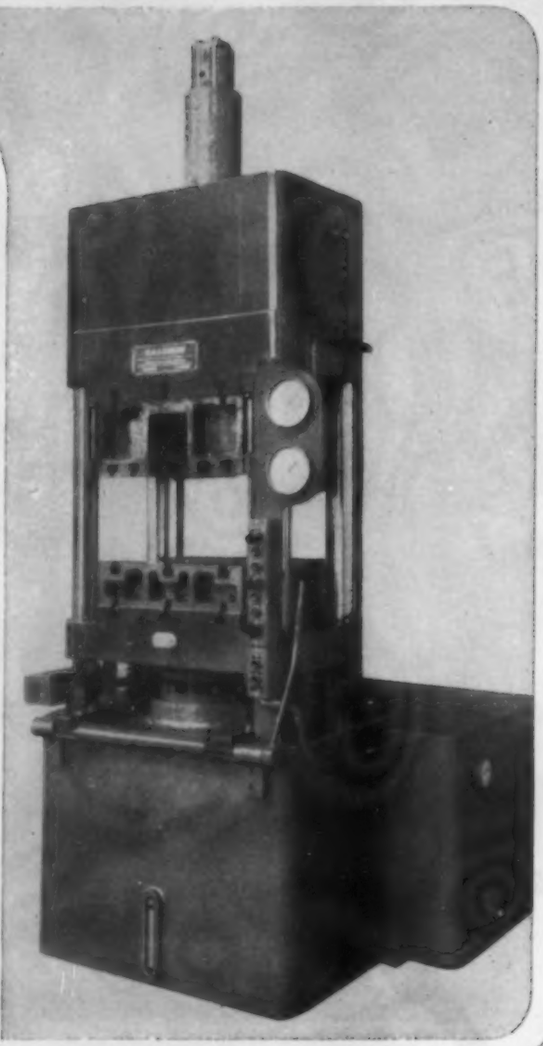
THE PLASTIC COATED YARN
REG. U.S. PAT. OFF.
makes its bow in the Auto Industry
Smart and sleek as the new cars they grace are toggle straps and lap-robe rails of PLEXON, the Plastic Coated Miracle Yarn.
Besides, they're abrasion proof, moisture proof, perspiration proof... will look well and give complete satisfaction for as long as the car itself! Chalk up one more important FIRST for PLEXON!
PLEXON, INC.
212 Fifth Avenue • New York 10, N. Y.

ANOTHER PRESS FOR TRANSFER MOLDING

The Baldwin Locomotive Works "Hy-Speed" plunger molding press is designed to make full use of pressure type Transfer molds. Shown at right is their self-contained press with a 25-ton top Transfer ram. A built-in timer facilitates fully automatic sequence timing for high-speed molding.

Transfer molding is the fastest method of molding thermosetting materials. Many manufacturers offer special Transfer presses that will do your thermosetting work faster, more economically and with lower mold investment than any other molding method.

For a fuller discussion of the advantages of Transfer molding, ask Shaw for a copy of "Transfer Molding and Your Product."



SHAW

SHAW INSULATOR COMPANY

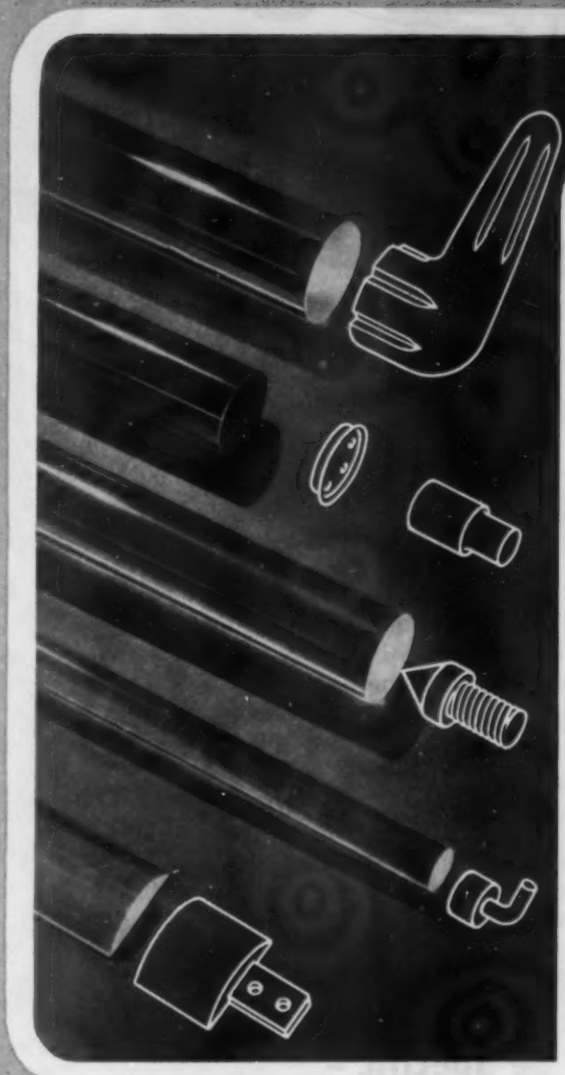
160 COIT STREET — QUALITY MARK ON MOLDED PLASTICS — IRVINGTON 11, N. J.

PLASTICS LITERATURE AVAILABLE

When your production plans call for thermosetting plastics, the logical first move is to consider Transfer molding. A list of licensed Transfer molding companies in your vicinity will be furnished promptly upon receipt of your request. Choose one — and allow him to work closely with your engineers and designers for best results.

To learn more about the specific advantages of Transfer molding, write Shaw. Engineering help in the form of bulletins and technical articles will be gladly sent you. Between the resources of Shaw and the Plax Corporation, Hartford 5, Conn., you can obtain assistance in almost all plastic methods and materials.

NOW PLASTICS IS HARDWARE



New applications for the various forms of the several plastic materials extruded by Plax indicate that we are now in the hardware business.

A little tool formed from Plax rod is being used by bricklayers to smooth the cement between tiles in fancy interior work. An improvement over the metal joiner formerly employed, it improves further with actual use.

Plastic push bars for doors and handles for utensils are, of course, a common sight. Their obvious superiorities over metal and wood in these applications make them, again, "not substitutes but improvements". Many are machined from Plax rod and tube.

And now thousands of new cars are sporting wheel rings formed from Plax's ivory cellulose acetate butyrate sheet—better and cheaper than any other way of accomplishing the same thing, and in many cases made practicable only because there is such a thing as plastic sheet.

Plax has no interest in the incorrect use of plastics and will advise against any application that is faulty. Plax does know what plastics are good for, and Plax makes plastics that are good. It's "Plax for plastics" that are "not substitutes but improvements".

PLAX PRODUCTION

Polystyrene, Polyethylene, Methacrylate, Cellulose Acetate, Cellulose Acetate Butyrate and Ethyl Cellulose are among the materials produced by Plax in the following forms: Rod, Tube, Sheet, Slab, Film, Fiber, Special Shapes, and Blown Items. Not all materials are available in all forms.

Between the resources of Plax and the Shaw Insulator Company, Irvington 11, N. J., you can obtain help and counsel in the use of most plastics materials and processes. For prices and technical literature on the materials listed above...write Plax.

PLAX
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NOT SUBSTITUTES···IMPROVEMENTS

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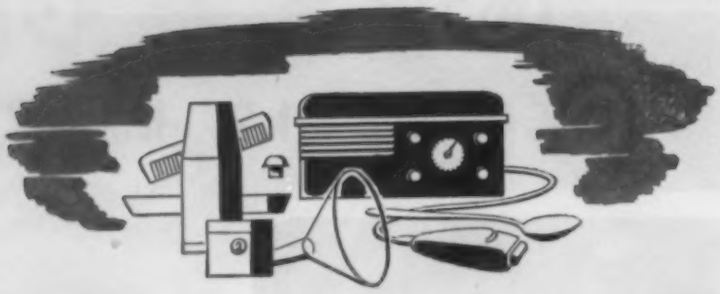

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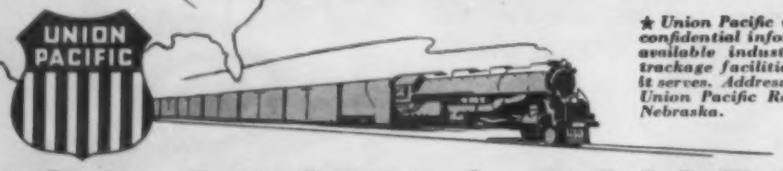

★ *Union Pacific will gladly furnish confidential information regarding available industrial sites having trackage facilities in the territory it serves. Address Industrial Dept., Union Pacific Railroad, Omaha 2, Nebraska.*

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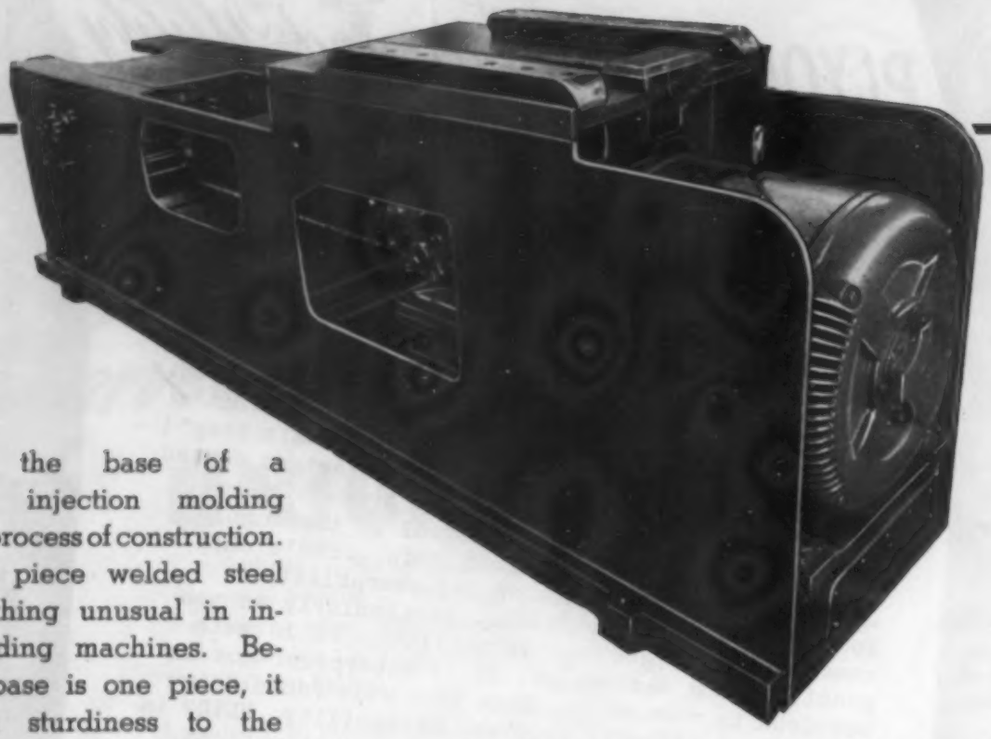

This is the base of a DEMATTIA injection molding press in the process of construction. It is a one piece welded steel base, something unusual in injection molding machines. Because the base is one piece, it adds much sturdiness to the strength of the entire finished machine.

It is only one of the reasons, of course. The others are listed in the box on this page. But even they do not tell the complete story. You must see a DEMATTIA machine in action to appreciate its strength, its performance, its economy. We will be glad to show you one in our plant.

Exclusive DEMATTIA *Features**

1. Actual die-clamping pressure over 400 tons.
2. Complete injection time two seconds.
3. Solid plate frame.
4. Plasticizing capacity: over 130 lbs. per hour.
5. Patented rolling action toggles non-wearing.
6. One piece welded steel base.
7. Injection pressures controlled to 30,000 lbs.
8. Hydraulic adjustment for die changes.
9. Valves, fittings, etc., mounted outside for accessibility.
10. Compact, saves space—only 38 inches by 12 feet.
11. Net weight 16,000 lbs. approximately.

* Above specifications refer to 12-ounce machine.

DEMATTIA *Machine and Tool Co.*

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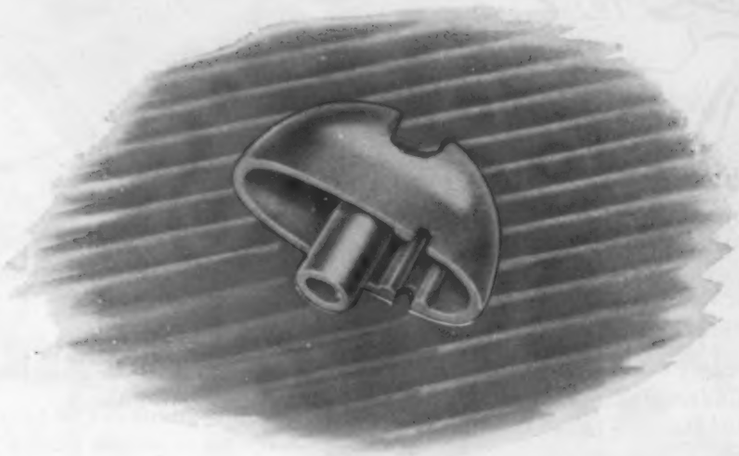
Cable Address: BROMACH, N. Y.



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If small plastic units play an important role in your business, investigate our production facilities.

Our automatic molding machines are ideally suited for low-cost, high-speed production of these items. Our special experience—we turn out many millions of small plastics a year—can help solve your problems of design, cost and speed.

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SEEN OUR NEW FLEXIBLE CONTROLLER?

YES, it's true. This Taylor Platen Press Control System is flexible enough for almost any kind of plastics molding job. It's particularly adaptable to short runs of products where the cure cycles vary.

The control temperature can be adjusted to suit the product. The duration of condensate discharge periods is adjustable. And the Taylor Flex-O-Timer (see drawing) is adjustable to the timing cycle as follows:

1. Total cycle is adjustable through the adjustable speed gear train—78 different drum speeds.

2. Actuating pins are fully adjustable so that lengths of each period in the sequence of operations can be varied.

3. Auxiliary timer permits cure period to be adjusted independent of other sequence periods.

4. Removable drums can be provided with actuating pins already set to permit a quick change for another mold setup.

Operation is completely automatic from the time you push the button until the press opens for the next load. Ask your Taylor Field Engineer or write Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada. *Instruments for indicating, recording, and controlling temperature, pressure, humidity, flow and liquid level.*

Taylor Instruments
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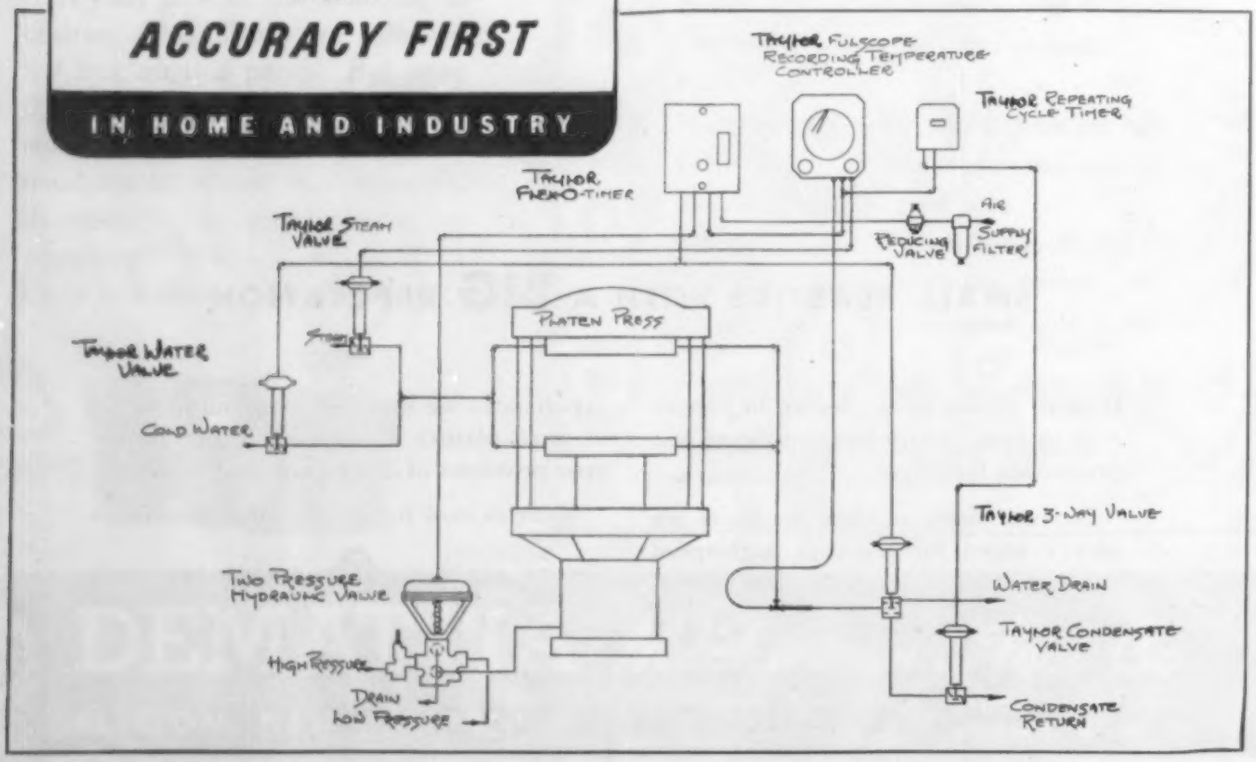
ACCURACY FIRST
IN HOME AND INDUSTRY



Stapler Base, illustrated herewith, was compression molded for the E. H. Hotchkiss Company of Norwalk, Connecticut.

—Even "Sticks and Stones" Won't Break Its Bones!

The above pictured part is a plastic base . . . tough, sturdy, rugged . . . which when assembled to a metal housing, forms a paper stapling device. Bombed daily by the impact of countless blows, its job is to *stand up* — and *stand off* abuse and rough handling. As Consolidated compression-molded of a flock-filled plastic, this unit has yet to meet the fist that can *break its back!*

Should you now be planning or projecting an item or part requiring a strong *backbone* . . . call Consolidated. Our know-how with plastic materials, mold construction and molding processes stands ready to serve product designers and manufacturers. With our modern production methods, you may be certain that your plastics projects will come thru the *right* way . . . the Consolidated way! Inquiries invited.

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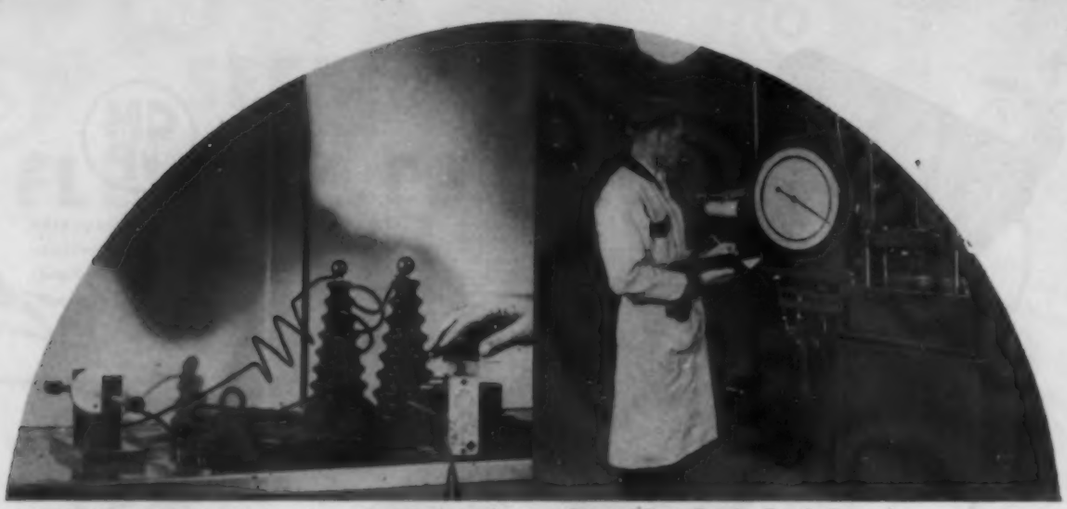

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IN PLASTICS AND METALS

PLASTICS, metals and plastic-metal combinations are opening new fields in design as illustrated by this assembly made by Auto-Lite. The spoke retainer, made of thermo setting plastic, carries chrome-plated stampings at each end and hidden inserts to hold the jewel-like, three dimensional, thermo-plastic center horn button. Another example of craftsmanship combined with utility . . . all available under one roof at the Bay Manufacturing Division of Auto-Lite.

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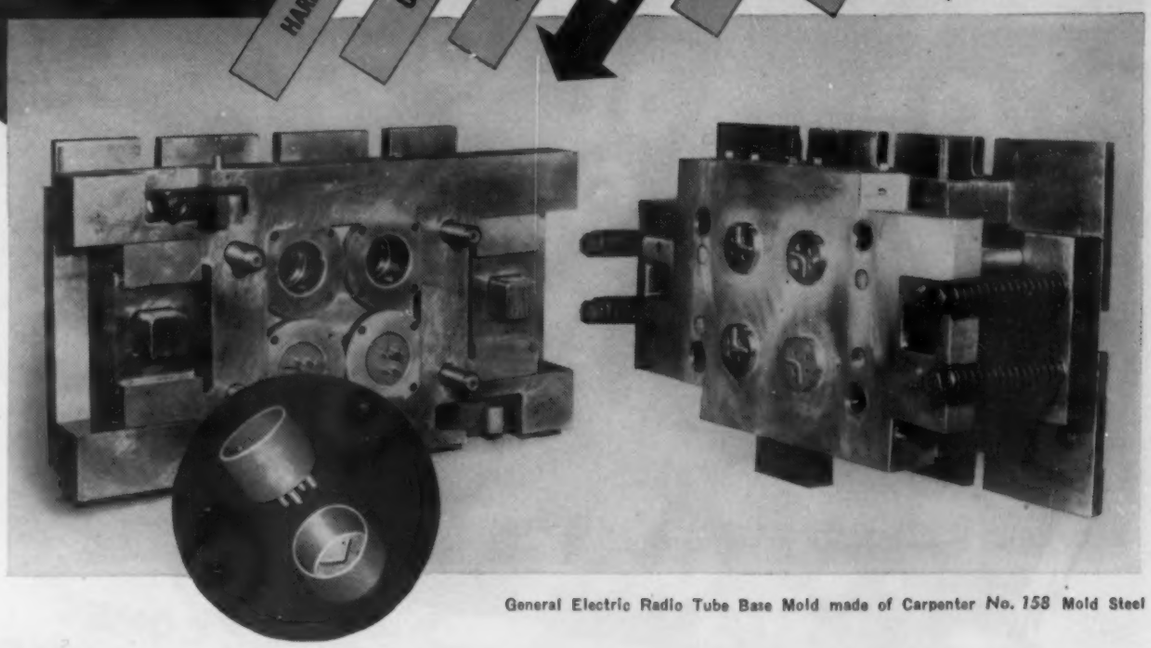
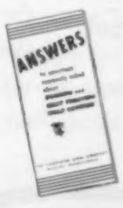


General Electric Radio Tube Base Mold made of Carpenter *No. 158* Mold Steel

● Cutting costs on your molding job calls for real ingenuity and skill—AND the right mold steel! For example, the mold requirements for making this radio tube base seemed never-ending. Exceptional strength was needed to prevent shearing of the ribs. Uniform hardness, extra wear resistance and freedom from distortion were absolute "musts". Because Carpenter *No. 158* Mold Steel met the "specs" it helped the mold maker cut costs from the tool room to molding presses.

By combining your mold making skill with sound, acid-inspected Carpenter Mold Steels you take a sure step towards better molding results at less cost. So contact your nearby Carpenter representative. Work with him—let his experience help cut your molding costs TODAY.



Here are useful answers to many molding questions such as, "Is process annealing of molds advisable?". For your free copy of "Answers To Questions Commonly Asked About Hobbing and Heat Treating Mold Cavities", drop us a note, indicating your title, on your company letterhead. Write today.

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IT ISN'T GRINDING OUT ATOMIC BOMBS BUT IT'S A TYPICAL FORMICA SITUATION

THE apparatus illustrated is a bit of plating equipment dealing with the all powerful if slower acting forces of chemistry and electricity, forces which when on the move have to be handled with better gloves than were ever made of leather. In situations like this one, Formica laminated plastic of high chemical and electrical resistance handles these forces better than any other material available can handle them.

There are many grades of Formica with special properties, from which you can make indestructible gloves to handle dynamic materials in scores of industries where chemicals and electricity are pretty hot to handle. Why not state your problems, or state the properties of the material you require and start a get-together for the purpose of ascertaining if Formica will best fit your needs.

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Prepare your new package design *now*. Then, as soon as raw materials again become readily available, you can *quickly* cash in on your products' full potentialities. A corrugated shipping box can be engineered in the H & D Package Laboratory to meet your particular packaging problems. Here "know-how" is based upon experience and research. Here thousands of corrugated boxes, large and small, are designed and engineered to meet every conceivable packaging situation, at the factory, in transit, in storage, at point-of-sale, in the hands of the consumer. Let the H & D Package Laboratory show you the advantages of modern corrugated package engineering. "How to Pack It" tells the complete story. The Hinde & Dauch Paper Co., Executive Offices, 4611 Decatur St., Sandusky, Ohio.

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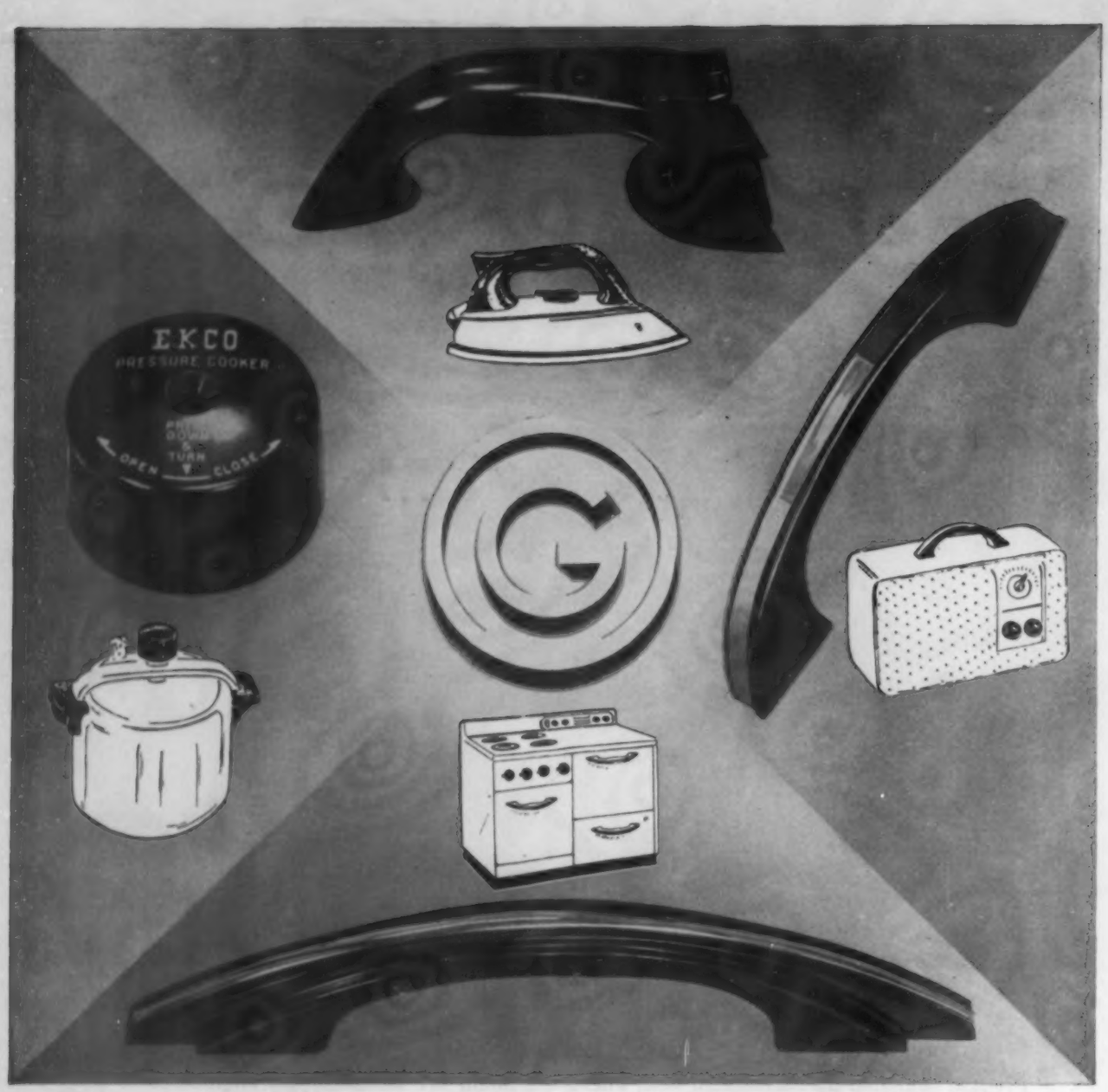

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For reasonably early availability, we offer an extensive "standard" line of handles, knobs and other parts for stoves, furniture and household appliances; also a large "stock" line of closures for foods, drugs and cosmetics.

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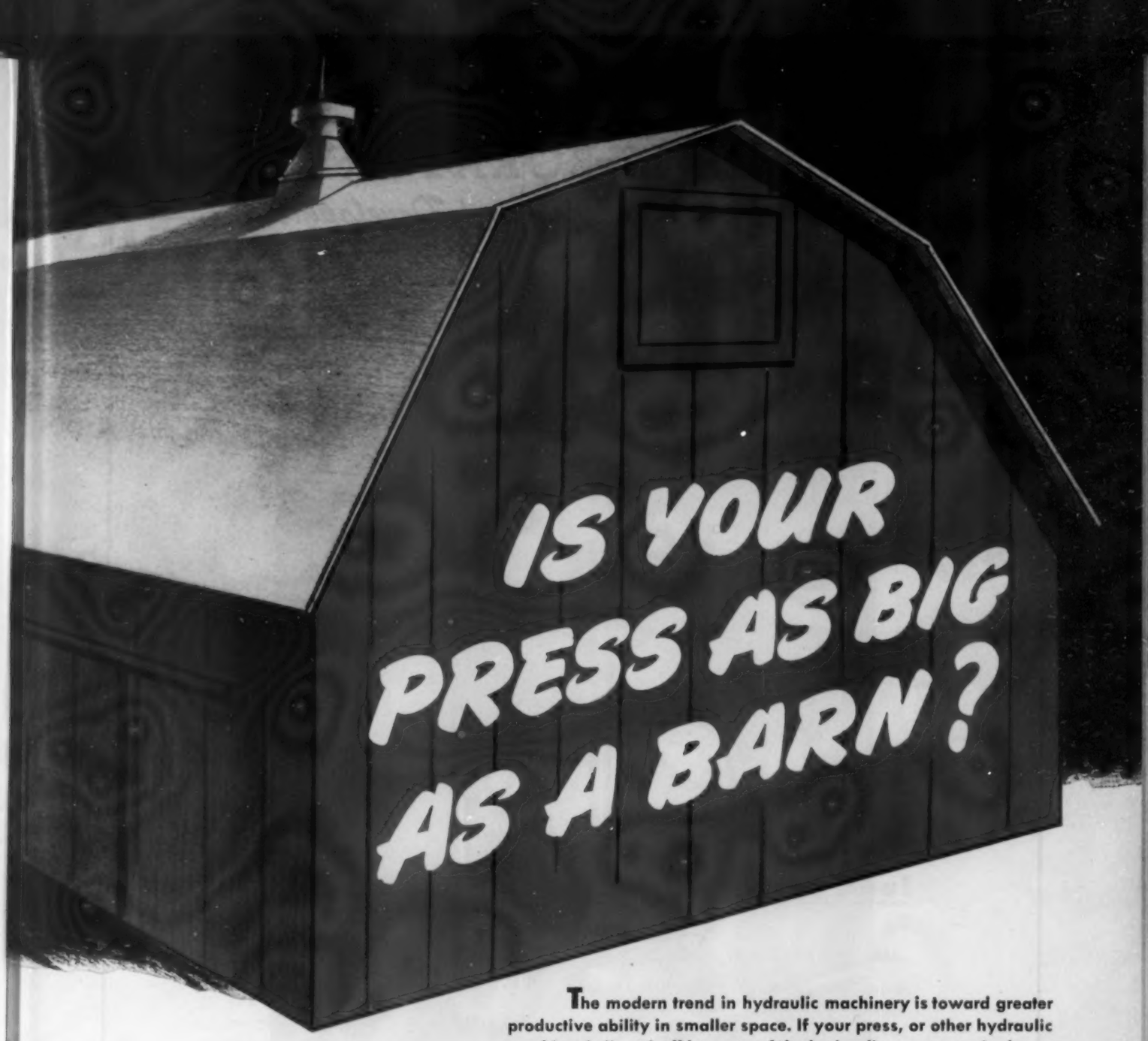

The modern trend in hydraulic machinery is toward greater productive ability in smaller space. If your press, or other hydraulic machine, is "outsize" because of the hydraulic power required, you can increase pressures and shrink the machine in all dimensions.

Until Superdraulic entered the picture, maximum pressures obtainable were in the neighborhood of 2500 psi. Now, Superdraulic gives you 5000 psi in a pump only 9 inches in diameter. This increased pressure permits the reduction of the size and weight of the whole structure, and results in important floor space savings. Now the press designer can—

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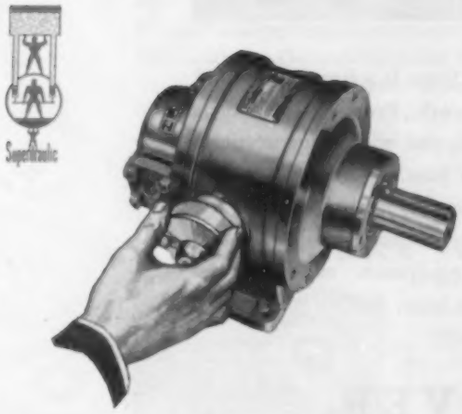
Write for complete, illustrated technical description of Superdraulic pumps, motors, and transmissions.



The Superdraulic pump delivers 5000 psi and 40 hp with volume ranging from 0 to 12 gpm, or 3500 psi with volume from 0 to 17 gpm at 1200 rpm. Its operation is under instantly responsive finger volume control or automatic pressure compensator control —infinitely variable volume and reversible flow. The Superdraulic pump is also available in constant delivery types.

Superdraulic Corporation

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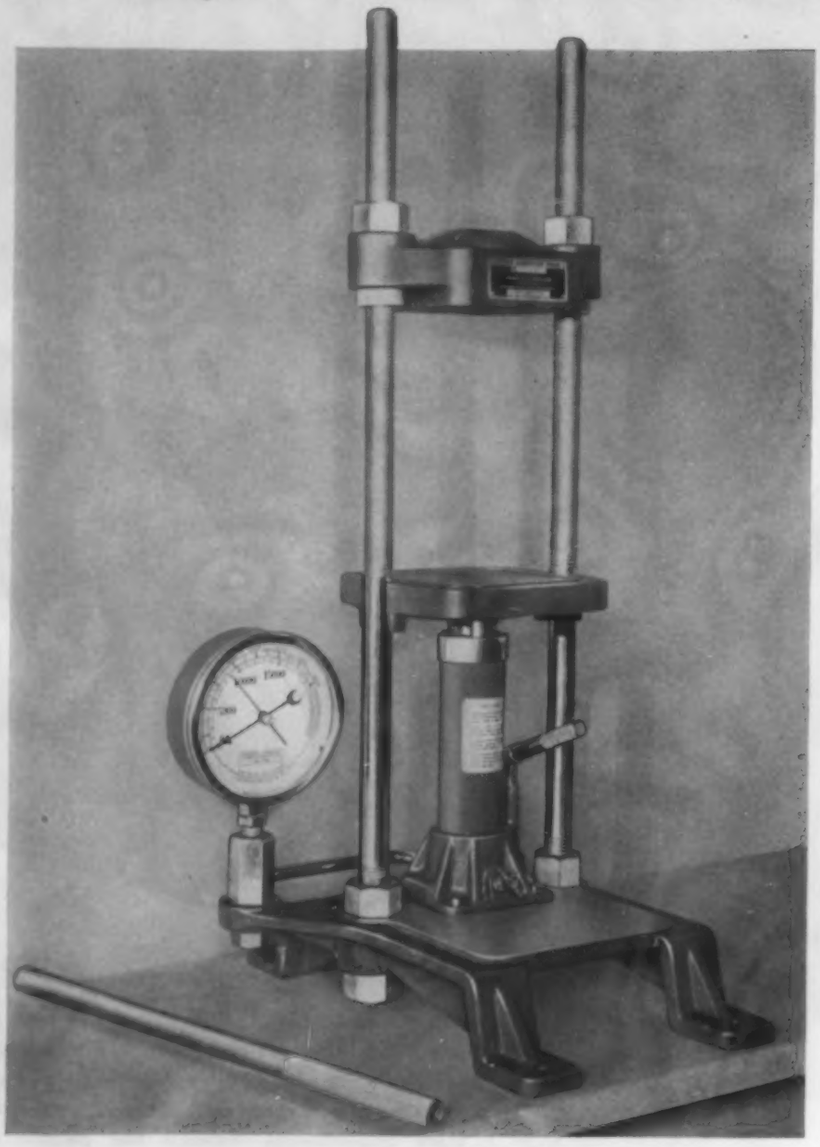

Original in design, built on experience, the Carver Press is a time-proved aid in plastics laboratory research and development work. Pressing capacity is 20,000 lbs., 160 times its weight of 125 lbs. Equipped with large accurate gauge of finest construction, rigidly mounted on base. Special gauges are available for low pressure work. Carver Press accessories include electric and steam hot plates and test cylinders. Additional interchangeable equipment includes swivel bearing plates, cage and filtering equipment, etc. The press and various of the accessories are patented. Send for latest catalog which gives full details, applications and prices. *Prompt deliveries.*

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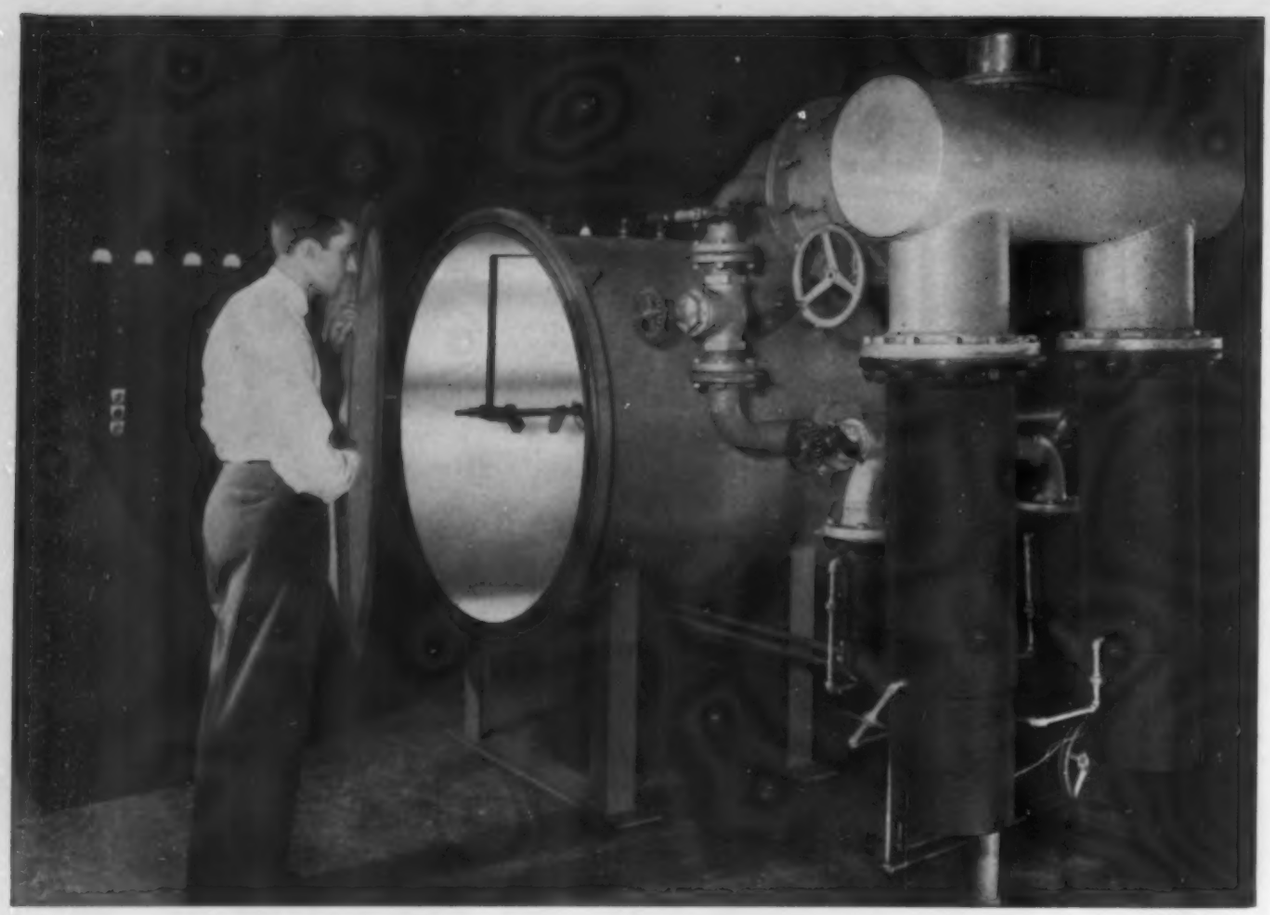

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Pistonless accumulator design eliminates line shocks for longer life of presses, piping, packing, valves, and dies. Elmes accumulators are ballasted by compressed air—have no *dead weight* which must be brought to an abrupt stop when flow is shut off—have no *internal* moving parts whatever; no ram; no packings . . . no leakage!

Patented Elmes controls work automatically to maintain high and low liquid limits within the vessel —*prevent* excessive withdrawal.

During periods of greatest demand, pump output to presses is augmented from the accumulator supply. As demand slackens, excess pump capacity recharges the accumulator. And when the upper liquid level is reached, the pump is bypassed. Throughout this entire cycle, the accumulator acts to *cushion* fluid flow.

The Elmes Pump-Accumulator System is a scientifically engineered combination of Elmes Accumulators, Elmes Patented Controls, and Elmes High-Pressure Pumps. We'll be glad to give you all the facts.

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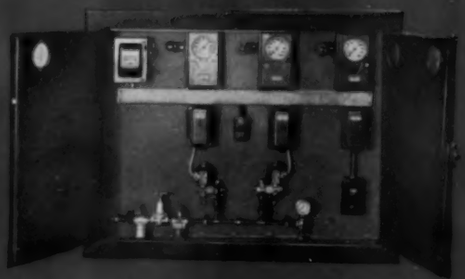
A typical Elmes pistonless-type accumulator. Has no packings; no internal moving parts. Can be set on usual factory floor. Compressed air ballasting assures uniform flow without line shocks; gives close pressure regulation. All pressures and volumes.



Cabinet-mounted electric control panel. Located wherever convenient near pressure vessel. Can include recording liquid level gauges on large installations.

Elmes six-plunger horizontal pump for 150 to 500 h.p. requirements, and pressures up to 35,000 p.s.i. Smaller pumps are vertical type. All embody every refinement of design and construction.

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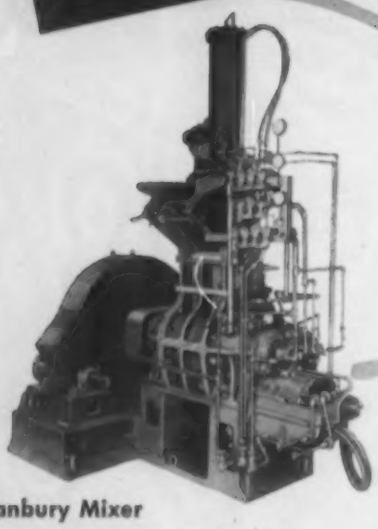

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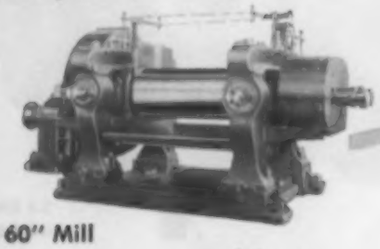

22" x 60" Mill

24" x 66" Four-Roll Calender

Economical processing of textile coatings, plastic film and similar materials is dependent, to a large extent, on a continuous flow of production. Especially in calendering, once proper running temperature has been reached and the gauge accurately set, interruption of scheduled output is costly.

The processing set-up illustrated in the diagram has been developed by Farrel-Birmingham engineers, working in conjunction with plastics manufacturers, to provide synchronized production in the progressive steps of manufacture. The first two machines, the Banbury and the mill, have a capacity of approximately 1200 pounds per hour, and are in ideal balance with the calender for the majority of products. The calender is driven by adjustable speed motor so that its output speed may be set according to the gauge of stock being run.

A number of single and multiple installations of these *Matched Production Units* have been made in plastics plants. In fact, the combination has given such satisfactory service that it has become generally accepted as the standard production unit for plastic film and coatings. Other combinations of equipment can be supplied to meet individual requirements.

For further details of these Matched Production Units, *write for free copy of Bulletin No. 183, just off the press. No obligation, of course.*

FB-343

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Test Data

Tensile Strength....3000 P.S.I.
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Life at 105° C.....2000 Hrs.
Chemical Resistance (room temperature)
50% Sulfuric Acid and
30% Sodium Hydroxide.....Unaffected
Does not support combustion
Low Temperature Flexibility
I.V.I. Pinch test.....—40°C.
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Heat Endurance (.166" ID tubing, .016" wall) ASTM-D350-43T): 7 days @ 125°C.—No crack when bent 180° around ¼" mandrel—Retains flexibility when varnished and baked 22 hours at 260°F.—No flow or drip during 8 hours at 300°F.

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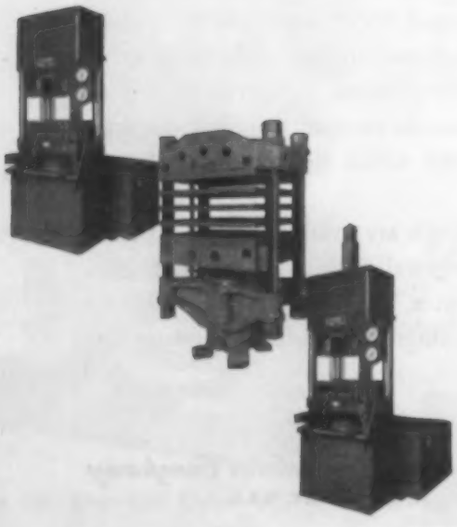

If there's ever a time when two heads are better than one, it's when an investment in new production equipment is being planned.

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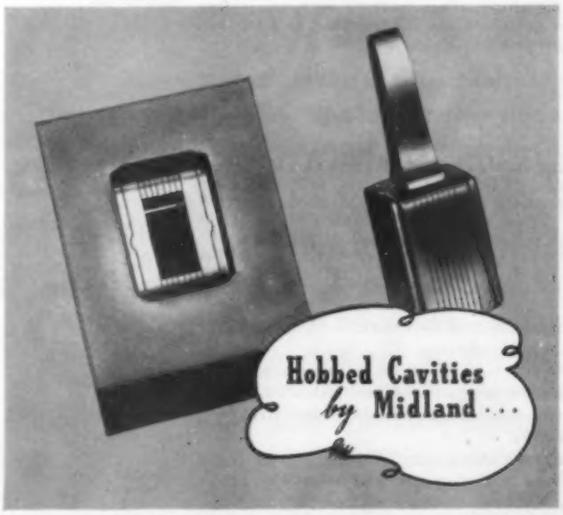

The arm of this towel holder bracket measures only 3/4" at the base and tapers to only 9/16" at the tip. It is but 13/16" wide—yet this Midland Hob is sunk a total of 3-1/8" into die steel to form a perfect hobbed cavity. It is capable of repeated use in making multiple cavity molds at exceptionally low cost.

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Acid value.....375-600
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Solubility.....Slight in cold water, infinite in hot water. Soluble in ether, alcohol and polar solvents.

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Combining weight.....145-150
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Solubility.....very slight in water, soluble in ether, alcohol, and many organic solvents.

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Average Molecular Weight.....362
Acid No.....2.0 max.
Average Boiling Point....232° C. at 5 mm.
Soluble in most common solvents. Compatible with most of the vinyls, nitro-cellulose, ethyl cellulose, cellulose acetate—butyrate, methyl methacrylate, etc.

PLASTOLEIN X-282

Compatible with nitrocellulose, with some of the vinyls like the butyrals, as a primary plasticizer, with others like the chloride, as a secondary plasticizer.

PLASTOLEIN AA

Titre.....5° C. max.
I.V.....135-140
A special fatty acid for baking alkyds.

PLASTOLEIN X-548

A low cost, ester-type plasticizer compatible with nitrocellulose, ethyl cellulose, and Buna N, with some of the vinyls like the butyral, as a primary plasticizer, with others like the chloride, as a secondary plasticizer.

Emery's new and enlarged unit for manufacturing azelaic acid, $C_7H_{14}(COOH)_2$, and pelargonic acid, $C_8H_{17}COOH$, is now operating after being shut down to permit increasing its capacity. Built in 1942 to produce commercial quantities of these acids for the first time, its output will now be doubled.

Azelaic Acid.....For alkyds, surface coatings, plasticizers
Pelargonic Acid....For alkyds, perfumes, plasticizers
X-55.....A plasticizer for the vinyls, elastomeric extrusions, surface coatings, coated fabrics, plasticized films
X-282.....A plasticizer for nitro-cellulose, a secondary plasticizer for fabric coatings—vinyls
Plastolein AA.....A special fatty acid for baking alkyds
X-548.....A plasticizer for Buna N, and mixtures of Buna N and the vinyls, high elongation, excellent ageing and easy milling

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MODERN PLASTICS
VOLUME 24 OCTOBER 1946 NUMBER 2

MORE PLASTICS *in the new airplane*

IT IS upon *more efficient service* that the air-transport industry is today basing much of its belief in a future marked by unprecedented expansion. By reducing the amount of maintenance needed on its planes and by cutting to a minimum the time spent on the work that remains, the airlines expect an increase in efficiency that will help them roll up a record in mileage per plane. By improving the comfort and appearance of airplane interiors, the companies hope to add to the number of passengers they serve and to make converts to air travel of every person who once has flown their lines. There are, of course, many other elements involved in the drive for more efficient service. But simply on the score of reduced and simplified maintenance and improved appearance and comfort, plastics can be expected to play an increasingly important role in the new airliners.

Just how important plastics are becoming to the airplane manufacturer is indicated in the articles that follow on pages 90 through 95. No attempt has been made to cover all the plastic parts that have become standard in this industry nor all the different types of planes in use on the different airways. Instead, the newer uses of plastics in two airliners have been highlighted to show how they add both to the *efficiency and the service* that can be expected of these ships.

Honeycomb structures and vinyl upholstery stand out as the volume uses for plastic materials. Between the two they may almost be said to line the passenger sections of the two planes we have described in this issue. In many instances they are used in combination, the vinyl covering used to surface the honeycomb construction.

Other plastics play an important part, however. The acrylics, for example, are used for more and more of the mirrors and lighting fixtures—adopted both for their non-shattering qualities and their good appearance. And then there are the high-pressure laminates for portable table tops, the phenolics and urea for knobs and various accessories, the melamines for tableware. Low-pressure laminates are used as interior finish in some planes, and in all of them the cellulosics find some application. In fact, it can be said that every type of plastics finds some role to play in today's big airliners—either as an operating part, a semi-structural member or as decoration and furnishing.

Plastics in the DOUGLAS DC-6

LATEST and largest in a long line of Douglas Aircraft Company, Inc., airliners, the giant DC-6 embraces a wide range of plastics applications. In fact, in view of the wide variety of plastic materials employed, plastics may be said to dominate the scene.

While the weight-strength ratio of plastic materials and their adaptability to the problems of modern illumination are responsible for many of the uses of these materials in the company's new planes, Douglas engineers and designers are finding new and distinctive qualities in the plastics now available which are not to be had, in the same combinations, in other materials. It has been the work of the Industrial Design Group, a part of the company's engineering organization, to study passenger comfort in all its many phases. These duties have, necessarily, involved rigid tests and the construction of full-scale mock-ups to show the durability of materials and their decorative values and to insure the correct engineering for seats, berths, windows and other components of the cabin interiors.

Current plans of this design group envision greater use in the plane interiors of molded and preformed components. Preliminary designs of molded wash basins and dental bowls, and the preformed window frames now in use in the DC-6, are examples of this prospective trend. According to E. Gilbert Mason, design consultant of the company, "we like plastics in applications of this type for a number of reasons. First of all they are clean in design and second, being in one piece, require almost no finishing. Also, they are easy to install."

Increased use of vinyls

Illustrative of the inroads that vinyl chloride covering materials and vinyl coated fabrics in general are making in this field are the many specialized applications of these colorful materials in the interior of the DC-6. Floor coverings in the entrance area, lounges and under seats in the main cabin are of a vinyl chloride material ranging in weight from 0.25 to 0.35 lb. per square foot. Possessing outstanding weight-wear properties, the material is impervious to acids, grease and most solvents, is flame and mildew resistant and can be scrubbed with soap and water.

Maintenance-wise, engineers of this company have designed these floor installations in laminated units which may be quickly removed for the periodical 250 or 1000 hr. maintenance, a standard practice in airline operation. The vinyl covering is layed over a $^1/_4$ in. ply of foam rubber, which is mounted on a cloth backing and fastened to the floor with mastic. Adding to a luxurious plush-like depth, contributed by the under layer of foam rubber, is the richness of the soft pebble grained surface textures.

A vinyl-coated fabric also covers the walls and ceilings of the entrance area, lounges, galley and bottoms of the upper berths in the sleeper plane. In those planes being fitted out for American Airlines, the vinyl material will be used as headlining in the main cabin. Vinyl-surfaced fabric is also used for the side panels of seats and as wainscoating under windows.

Functionally, these vinyl fabrics perform many services. On certain bulkheads the fabric is stretched over a layer of mat type Fiberglas being held in place with metal or attachments so it may be easily removed for replacement or maintenance. In other places the fabric is mounted over milkweed floss or mounted permanently over upholstered panels. While many engineers

prefer worsted and other types of fabrics by virtue of their acoustical properties, a wide variety of vinyl coated fabrics with surface textures soft enough for adequate sound absorption have been developed under the guidance of Douglas' plastic engineer, R. J. Considine. This type of application is a solution to the dry cleaning problem, a critical procedure of airline maintenance, which arises when conventional fabrics are used. The design groups are now working on a nylon fabric as a replacement for conventional fabrics now used for some headlinings, curtains, upholstery.

Another Douglas innovation in the use of vinyls, which materially broadens their scope of possibilities in the aircraft field, is an extruded vinyl strip material used for the bottom of seats and berths. Attached crosswise on the bottom of a seat, the vinyl strips form a spring structure which permits the use of a thinner, cushion and, incidentally, insures even greater passenger comfort.

Seat and berth components

Seating, one feature of an airliner where luxury is measured in terms of sustained, unvarying comfort, also makes use of plastic components. A plastic button, for example, positioned at the inside of the arm rest near the passenger's thumb, activates the hydraulic mechanism controlling the reclining back without the necessity of the passenger moving out of position at any time. Shielding the reclining mechanism installed beneath each seat are shrouds formed of phenolic laminates.

Secured in a storage pocket in the back of each seat is an adjustable table with a top fabricated of a sandwich laminate incorporating a honeycomb core faced with a decorative laminate of impregnated fabric. When fitted into the arm rest of a chair, the table may be positioned for the convenience of either thin or stout people. Here again the light weight, strength and appearance of plastics are called into play to contribute passenger convenience.

Adjacent to berths are transparent stowage pockets which reduce the possibility of passengers overlooking personal effects. Still another far-reaching contribution of vinyls toward the mounting volume of plastic materials being incorporated in the makeup of today's super airliner is an extruded flame-resistant thermoplastic molding used around bases of cabinets in lounges and at the joint where the floor and fuselage meet. Developed to Douglas specifications, the molding is flexible enough to form around a 2 in. radius and can be produced in any dull finished solid color.

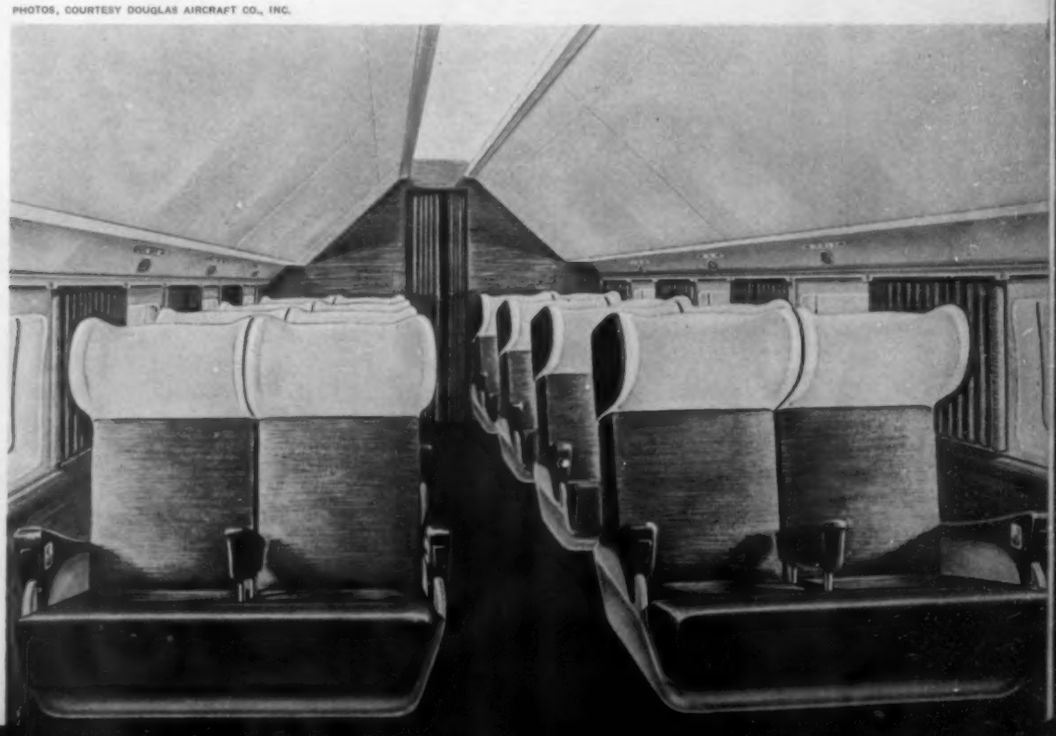
A distinguishing feature characterizing the DC-6 is its large square windows, 16 by 18 inches in size. The material for the frame is thermoplastic and incorporates an elastic memory similar to that of acrylic. The frames, the inside depth of which approximate the thickness of fuselage walls, are drawn from the flat sheet stock.

Uses for acrylics

Outstanding among the applications for acrylics in the DC-6 are large mirrors. Some of the largest of these mirrors, which add to the utility as well as attractiveness of the men's and women's rest rooms, measure 30 by 40 in. and 15 by 60 inches. In addition to effecting a saving of weight of approximately 50 percent, the mirrors possess an unusually high mirror quality.

Lining the inside of a folding door, which serves as the entrance to the ladies' dressing room, are two full length mirrors, each 15 by 60 in., which form a 30 by 60 in. mirror when the door is closed. Supplementing this is another large quarter circle mirror over the dressing table which measures 40 in. across the base. Smaller mirrors, also of acrylic, are convenience features of both men's and women's lounges—in the former for shaving, in the latter for dressing table accessories. These are self-lighted and fully adjustable. The same type of adjustable mirrors are provided for passenger comfort in both upper and lower berths.

PHOTOS, COURTESY DOUGLAS AIRCRAFT CO., INC.



Interior view of an airplane sleeper shows many plastics in use. Side panels and fairing of seats are of vinyl-covered fabrics; push buttons and knobs are cast phenolic; serving tray, which may be attached to arm rest, is a melamine paper laminate

According to company engineers who cooperated with the manufacturers in the development of this application, the physical characteristics of the acrylic material eliminate for the first time the almost prohibitive breakage of large glass mirrors which formerly occurred in both installation and in the maintenance operations.

In conformity with a long-established custom adopted by the engineers in the construction of other DC-models, acrylic is the material from which the plane's windows are fabricated. The windows, incorporating a new design principle engineered for pressurized cabins, comprise two thicknesses of acrylic separated around the outer edge by strips of the same material. Between the inner and outer sheets which are 1/4 and 3/16 in. in thickness, respectively, is 1/4 in. of dead air space. This space is said to prevent frosting or fogging. A slightly curved window surface is produced through the means of a simple bend.

Lighting the ship

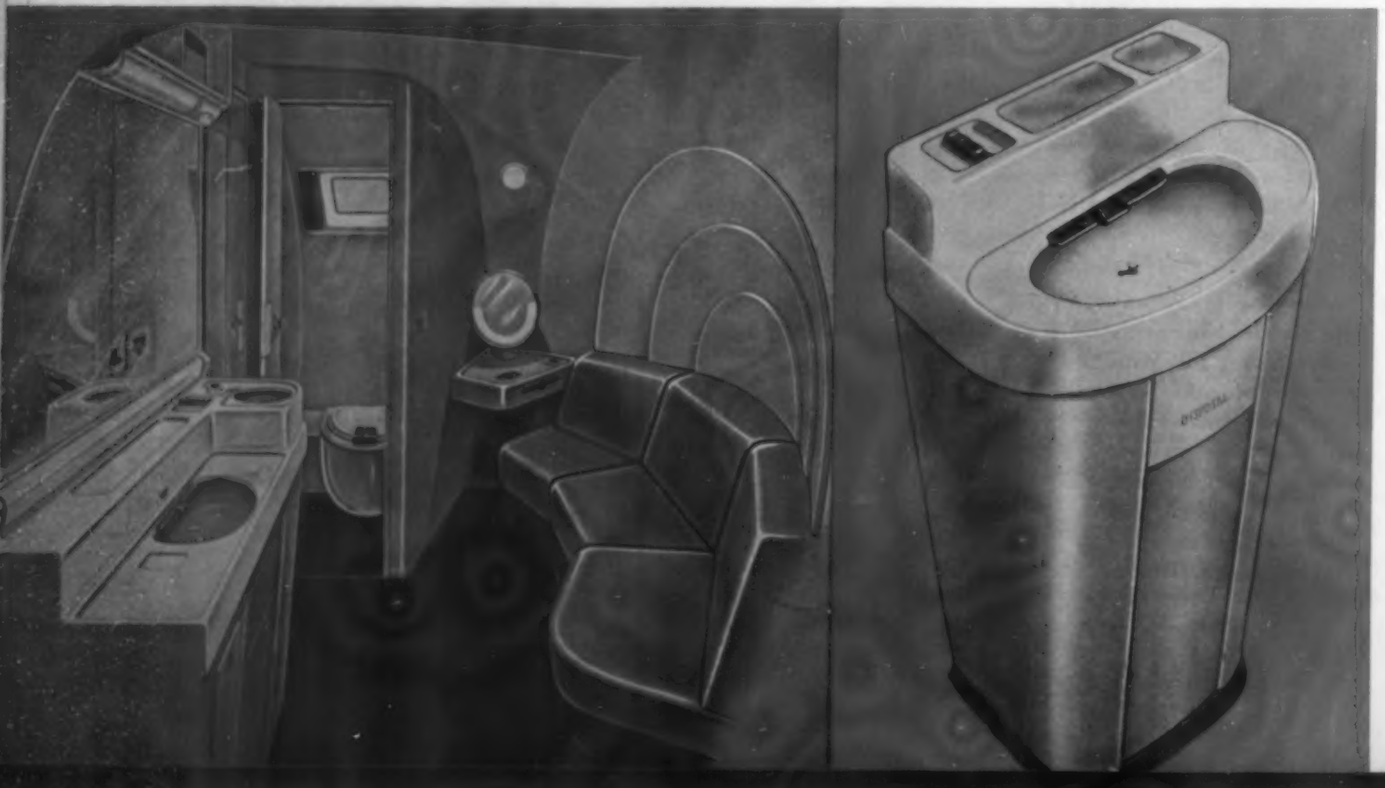
Indirect lighting, reflected from a continuous ceiling fixture, is the principal means of illumination employed in the main cabin. Recessed in the headlining at the center line is a broad continuous reflector fashioned from a low-pressure glass cloth laminate bonded with polyester type resins. Featuring a smooth glossy white reflecting surface, this laminate is slightly concave in shape. Here, again, multiple properties of the plastic member are called into play. First the material must be light of weight, then the surface must be washable. The material must incorporate high abrasive and heat-resistant properties. It must also be formable as well as resilient.

Positioned below, and extending parallel along either side of the reflector, are two continuous valance-like angles of translucent acrylic, each of which shields or boxes in a row of incandescent lamps. A loosely woven translucent fabric covers the ceiling surface which slants gable fashion from walls to outboard edges of the acrylic angles, and then continues on over their exposed outer surfaces. The fabric thus serves to screen or break up the light which would ordinarily shine through the perpendicular sides of the acrylic valances and eliminates the black streak which would be produced along their horizontal under surfaces.

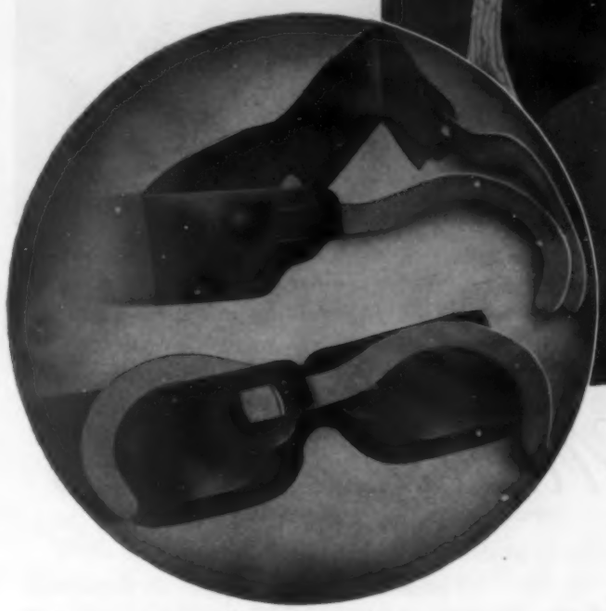
The ultimate in both quality of light and perfect diffusion is achieved in men's and women's lounges through the medium of continuous translucent acrylic fixtures positioned above and along the base of the large plastic mirrors. The light below the mirror plays on the under side of the passenger's chin and at the same time sheds full light on basins and dental bowls. Supplementary lights are incorporated in the smaller adjustable plastic mirrors provided for shaving and in those that are positioned at either end of the ladies' dressing table.

Plastics are again utilized to contribute a touch of luxury and utility in the form of red-colored plunger bars for the wash basins. Three of these bars, which serve as controls for hot and cold water and for the release of hand and shaving lotions, are installed in each basin. The plunger bars, developed to Douglas specifications, are fashioned of cast phenolic. Semi-translucent, they feature flush letters. The same material is used for hot and cool-air adjustment knobs positioned for the passenger's individual comfort in berths and near seats throughout the plane.

Left—A de luxe ladies' lounge has mirrors, lavatory window and light coverings of acrylic. Flooring makes use of rubber-backed vinyl-coated fabric. Right—Wash basin features translucent phenolic knobs



Below—Bodies of the sun goggles are die cut from sheets of cellulose acetate; the temple pieces can be cut from the same material or from a three-ply laminated fiber stock



PHOTO, COURTESY UNITED AIRLINES

Above—To ease eyestrain, air passengers are offered lightweight, shatterproof plastic sun glasses. Goggles fold up to fit pocket or purse, are adjustable to 3 sizes

SUN GOGGLES *for air travelers*

PLASTICS IN THE AIR

THE view from an airplane may be magnificent, but eyestrain is no more welcome in the air than on the ground. And it's not every air passenger who remembers to bring his sun glasses along.

To meet this problem, a number of airlines are now making available to their patrons lightweight sun goggles fabricated from Fibestos. The goggles are shatterproof and may be easily adjusted to three sizes to fit either a child or an adult. Having no rim, they permit unobstructed vision, provide side as well as front protection from glare and may be worn over regular eye glasses if desired. When not in use, they fold compactly into an envelope, fit easily in pocket or purse.

United Air Lines, which pioneered in the use of these plastic goggles, will continue to make them available as a flight service feature of the company's new 52 passenger Mainliner 300. On each United flight, the plane's stewardess distributes the goggles, free of charge, to any passenger wishing to wear them.

The Clear-view plastic goggles were developed by A. B. Mull of the Spotswood Specialty Co. and are fabricated by that organization. The main body of these convenient eye aids is die cut from 0.0075 in. thick sheets of cellulose acetate, tinted dark to reduce glare. Temple pieces, separate from the lens fit into slits cut in each side of the main body. These temple pieces are die cut from either clear cellulose acetate sheet material or from 3-ply laminated moisture-resistant fiber stock. A small U-shaped tab in each temple piece can be fitted into the slits, adjusting the goggles to three sizes.

In addition to United Air Lines, a number of other airlines, operating both in the United States and abroad, are now distributing the goggles with their own special imprint. Instructions for adjusting the temple pieces are printed on the envelope holding the goggles. The use of these handy, economical eye aids is not confined to the airlines, however. Bus companies, railroads, oil companies and other organizations serving the public are also studying the distribution of the goggles for their own operations.

The cockpit evidences uses of plastics on the instrument panel and walls—both covered with vinyl-coated fabrics

Wainscoating, luggage compartments, chair arm covers, all utilizing vinyls, add comfort and color to surroundings

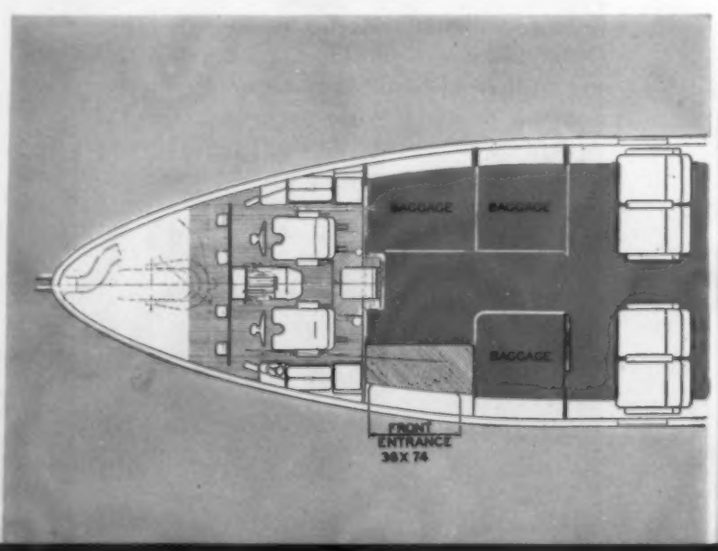
PLASTICS *in the Martin airliners*

THE management of the Glenn L. Martin Co. realized early in the war that increasing efficiency in aircraft would depend to a large extent upon new applications for plastic materials for structural use in planes. It also realized that by the proper use of colorful and durable vinyl materials luxury air liners could be given styled interiors in keeping with their purpose. The direct result of the Martin approach to plastics was the development of a honeycomb structural panel core produced by United States Plywood Corp. under license from Martin, and Martin's own Marvinol vinyls to be marketed by the Plastics and Chemicals Div. of the aircraft concern.

In the two newest Martin Liners, the 2-0-2 and the 3-0-3, both twin-engined, high-speed planes, extensive use of these plastic materials and others has been made to improve performance and economy of operation, as well as passenger comfort. The 3-0-3 has a pressurized cabin, a jet thrust augmentation for extra speed as well as several other noval features. The 2-0-2, which is designed for operation on main domestic trunklines, is the final result of 21 designs and has many features similar to those in the 3-0-3.

The drawing which appears on these pages shows the use of honeycomb on bulkheads and partitions. The floors will be built in 15 pieces amounting to over 240 sq. ft. and will be surfaced with heavy vinyl-impregnated cloth. Partitions will be similarly treated. In each wing a section around the center spar and a rib of honeycomb material will be used to separate the four fuel cells. Luggage racks, walls, instrument panel base and interior doors will also combine honeycomb with vinyl coverings.

The honeycomb construction is the most efficient core material so far produced for lightly loaded panels where weight and stiffness determine design. The same basic internal structural principles apply to all



Honeycomb material will be used in construction of new commercial airliners. Here a blueprint indicates its use for baggage compartments, bulkheads and the entire floor

honeycomb cores. The core, between sandwiches of metal or plywood, is made of a resin-impregnated sheet material which has been cured and assembled into the form of nested cells, usually hexagonal shaped, resembling bees' honeycomb. Many different types of fabrics, papers or fibrous combinations may be employed, though the end use of the sandwich will naturally determine the selection.

Different types of honeycomb

The Martin Co., (together with the United States Plywood Corp.,) have developed several honeycombs with differing core materials and various weights and types of facing. All core materials, whether paper, cotton cloth, Fiberglas or linen, are impregnated with phenolic resin before being assembled into the original honeycomb pattern. For facing materials they use various aluminum alloys, stainless steel, wood veneers and plastic sheets, either singly or in combination, When no heavy strains are to be placed on the panel, wood veneer can be applied directly to honeycomb.

Thickness of the core can be from $^1/_8$ in. upward and sheets as large as 7 by 30 ft. have been made. The weight of those honeycombs may be as little as 4 lb. per cu. ft., a very important consideration when specifying its use for airplane construction.

Working with honeycomb structures

While so far the majority of uses which have been visualized and in which experiments are being conducted are for the honeycomb in flat sheet form, manufacturing techniques are being assayed to make possible the fabrication of curved sections of honeycomb. It has been discovered that the internal assembly of the cells directly affects the final shaping of the sheet, that certain shapes of cells lend themselves to certain final forms. For instance, the standard hexagonal-shaped honeycomb is used where the final form is to be saddle backed. Single curvature bends require a square patterned honeycomb, and double curvature or domed shapes demand honeycomb cells of trapezoidal plan.

Applications for vinyl

As trim, 400 ft. of 54-in. vinyl material will be used in each airplane. To fill the specifications of the various airline purchasers, the company is stocking this material in two weights—7 or 8 grains—and in a limitless range of colors. Arm rests, scuff rails, bottoms of hat racks, lavatory interiors and galleys are some of the locations in which vinyls will appear. They will also be used for small parts such as insulation and technical sleeves for electrical systems, door latches and bumpers, gaskets, washers and knobs. Tests have shown that these resins are both lighter in weight and more serviceable than materials previously employed for those items.

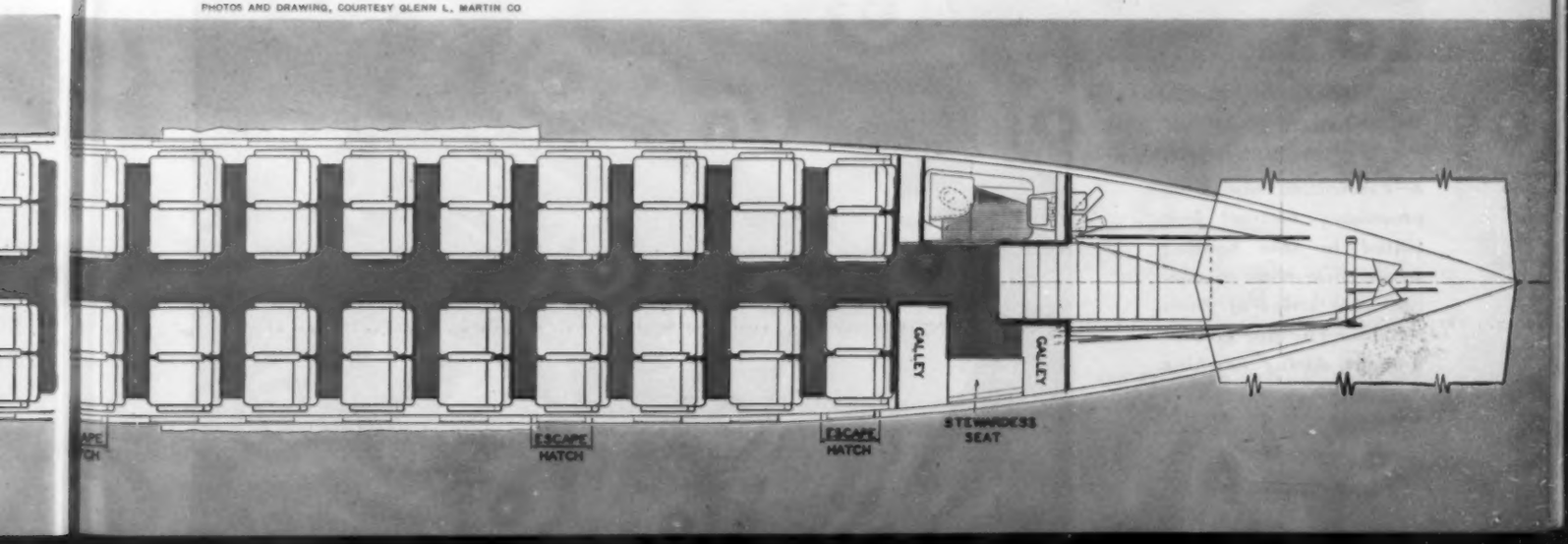
Until Martin's new vinyl plant gets into production in 1947, vinyls of other manufacturers will be used. Even when it starts using its own material, the company will make only the raw materials for others to fabricate. The resins will vary from a rigid to a soft rubbery state and will be marketed in a granular, white powder form.

Other plastic applications

The so-called standard applications of plastic materials to accessories, appearing in the new Martin planes, include instrument housings, knobs, dials and handles, that will feature phenolics in either molded or laminate form. Serving trays and dishes will be melamine. The flight attendants' telephones will probably be molded from ethyl cellulose. Mirrors, as presently planned, will be metallized acrylic. Indirect lighting fixtures may be made of translucent plastic laminates.

Since this company has a considerable direct interest in plastics, it is not surprising that its engineers have used them to good effect in its new airliners to add to both the efficiency of operation and to passenger comfort. To achieve these two goals the engineers of the company spent months "living with" the airlines to get a view of their requirements and ideas for plane arrangement. They worked closely with operations, traffic, flight and maintenance personnel to obtain their "musts" of design and arrangement. From this experience came the full realization of the importance of upholstery materials that are easy to clean and resistant to wear. This "living in" also emphasized the benefits to be derived from the use of honeycomb structure which is strong and light and can be installed so as to simplify maintenance work.

PHOTOS AND DRAWING, COURTESY GLENN L. MARTIN CO



A two-toned cast phenolic radio housing

COLOR and styling are important selling points in any household item, doubly so in an article that takes as prominent a position in the home as does the radio. Appreciating this fact and anxious to get the maximum of both color and styling, the Bendix Aviation Corp. selected a cast phenolic for the housing of its new Bendix radio.

A six-piece fabricating job

The question of material for the cabinet was complicated by the unusual design worked up by Frank Glover. As can be seen by comparing Figs. 1 and 2, what appears at first glance to be the front plate is in reality the front, base and bottom of the cabinet. And to further complicate the production of this piece, the design was developed with five shallow grooves running horizontally across the face of the part.

Fabrication seemed the best answer to the processing problems created by this styling and Catalin the material that would give the variety of color the designer and manufacturer wanted, coupled with good machining.

The castings for the combination front-base-bottom section, the U-shaped cover and the two curved end pieces that fit on either side of the dial are finished by the Plastic Turning Co. The two knobs used on each of the models are fabricated by the same company from rod stock.

Except for the grooves on the front of the base piece, not too much work needs to be done on the castings. The grooves, however, require the attention of skilled workmen who can turn out the finished pieces without loss of time or damaged parts. The fabricator is also responsible for the boring of assembly holes and for the holes through which extend the shafts for the tuning and volume controls.

All the assembly work is done by the fabricator. It is rather a revelation to see how compactly the cover section fits over the shafts of the base, leaving a band of the base material showing along the bottom on either side. And, with hardly a separation line to show that the end wedges on either side of the dial are not part of the cover section, these two small curved pieces are bolted firmly to the top. It is difficult to see how the engineers and the plastic fabricator could have more faithfully reproduced the design of the artist. There is no evidence of compromise in an effort to simplify or lower the cost of production.

Running the color gamut

No matter what the color scheme in any one of these radios, the combination front-base-bottom section always provides the contrast. With the knobs, end wedges and cover in a mottled green or tan, the front will be fabricated of black or green cast phenolic. And there are combinations to fit most any color scheme.

1

1—Six cast phenolic parts comprise this radio cabinet—the front-base section, cover, 2 end wedges and 2 knobs

PHOTOS, COURTESY THE CATALIN CORP.

2

2—Fabrication seemed the processing method best suited to this housing where cover rests on narrow side strips of front section. The five grooves are cut during finishing

Paper plastics surfacing

Samples of plywood surfaced with resin-impregnated paper. Shown top to bottom are: Oak face plywood with texture finish; Maple face, satin finish; Walnut face, satin finish; Birch face, satin finish

by WILLIAM B. DARLING*

DURING the past few years considerable work has been done on processes for applying a plastic surface to plywood and wallboard, particularly the former. While it is obvious that such a surface may be applied as a liquid coating or in the form of a film, this article will deal only with the use of a film composed of paper which has been impregnated or coated or both with thermosetting resin, principally phenol-formaldehyde or melamine-formaldehyde.

Types of surfacing

Plywood can be made of either hard or soft woods or a combination of the two. Surfacings can either be opaque—to hide the natural appearance of the wood surface—or transparent—to permit the grain of the wood to show clearly. Opaque surfacings usually include pigmentation of some kind, making it easy to incorporate color. The transparent surfacings may be tinted with dyes which have little or no hiding effect. Printed designs on opaque surfacings have been made and, for the future, present a variety of possibilities.

Either type of surfacing can be applied to any of the types of plywood mentioned above in a hot plate hydraulic press. The opaque type requires less pressure than the transparentizing type. Consequently, it is easier to handle. Resin content has a decided influence on the pressure necessary for application, and on the curing cycle as far as the opaque surfacing material is concerned. There is also a possible variation in the curing speed of various resins, advanced resins curing much more rapidly than other resins in the early stages of condensation.

Paper used in surfacing

At this point it might be well to describe rather fully the papers which have been developed in the Riegel Laboratory for surfacing purposes and to make some

* Riegel Paper Corp.

comparison between results which may be expected from these papers and results obtained by using coated papers and papers impregnated by different means.

It has been established that resin may be added to paper during the process of paper manufacture. The old method of impregnation was to add the resin to the paper as a secondary operation after the paper had been manufactured. It seemed obvious that if this secondary operation could be avoided, an economic advantage would be gained.

In the secondary impregnation process there is almost invariably a higher percentage of resin on the surface of the sheet than in the middle of it, due to the fact that the paper tends to filter the resin solids to some extent. In the single operation, there appears to be much more resin in the center of the sheet than on the surface. Further, the resin appears actually to enter many of the individual fibers, a condition which does not seem to prevail in the secondary operation process. As a result, better bonding of individual fibers to each other occurs both because of the complete saturation of the resin and because the resin is in a more fluid state. Under the action of heat and pressure, the paper loses its fibrous structure and becomes a homogeneous mass (rather than an obvious laminate) stone-like in structure. Also because of the fluidity of resin in the sheet, there is a large amount of resin flow, and fiber flow is clearly noted.

Either type of impregnated paper will be self-bonding to plywood or wallboard at pressures as low as 150 p.s.i. provided enough resin is present. Usually the minimum amount is somewhere between 35 and 40 percent. In papers made by the secondary process of impregnation, the problem is to make sure the resin is completely through the sheet rather than to secure a good glue line bond. With single process impregnated papers, the problem is quite reversed since resin must be forced out of the sheet to the surface to secure needed glue line.

Opaque surfacings may be secured in three ways.

First, a paper may simply be coated with resin and adhered to the core material by means of an additional glue line. This results in a highly protective surface but does leave the paper open to attack by moisture and other outside influences through unprotected edges.

Second, paper may be impregnated with a very low percentage of resin and adhered by an additional glue line. Since resin tends to transparentize the paper, a low resin content will cause a minimum of transparency, thereby presenting an opaque surface. In this case, there is insufficient resin for thorough protection of the fibers in the sheet but the paper itself is equally protected throughout, both flatwise and edgewise.

Third, an opacifying pigment may be added in a relatively high resin-content sheet to overcome the transparentizing effect of the resin. Such a sheet will present

Other plywoods having resin-impregnated paper as a surfacing are: Douglas fir given a high-gloss mirror finish (lower left); Oak with a satin finish; Mahogany-face plywood with a satin finish (top, right)

a hard surface highly resistant to attack both edgewise and flatwise. Ordinarily it will not require an additional glue line since high resin content makes it self-bonding.

Paper which will transparentize when properly applied to a core material necessarily must have a high resin content, from 50 to 55 percent. There are, of course, many degrees of transparency. The process for making a paper which will transparentize to the highest degree is at present a commercial secret which cannot be disclosed. It involves the type of fiber used, the treatment of that fiber in stock preparation, the type of resin used and the means of introducing it into the fiber. This is quite the opposite of what is the case with opaque surfacing where fiber or resin make little difference.

High-density board necessary

The conditions for surfacing wallboard composed of pressed cellulose fibers are essentially the same as those for plywood except that a soft or low-density type of wallboard cannot, apparently, be used successfully. This is due both to the fact that the paper-plastic surface is applied under pressure, which distorts and compresses such wallboards, and to the fact that such a board does not have sufficient binder between individual fibers to prevent separation internally as a result of the release of steam when the inherent moisture in the fibers is released by the heat used to cure the resin. A hard-pressed high-density board must, therefore, be used. Care must be taken with mineral types of wallboard since some materials, such as gypsum, break down under the action of heat used for curing. Other types, such as asbestos, are highly alkaline and must be acidified in order to secure good resin adhesion. Keeping these things in mind, the following facts would apply to either wallboard or plywood of similar densities.

Press conditions

The press should be very carefully aligned and adjusted so that as nearly as possible, equal pressure is applied over the entire surface to be pressed. All heated platens should be as close to the same temperature as possible; and temperatures should be maintained as evenly as possible. A pressure of 100 to 200 p.s.i. is necessary for opaque surfacing and a minimum pressure of 250 p.s.i. is presently required for transparentizing surfacing. For phenolic resins, a curing temperature of 300 to 310° F. should be maintained; for melamine resins, the temperature of between 270 and 300° F. Curing cycles range from 5 to 20 min. depending on heat transfer, type and percent of resin used, and moisture present.

Material conditions

The material to be surfaced should be dried to a minimum moisture content (5 to 8 percent). Any binder used in it should be of a kind that it will not break down or release under the temperatures necessary for curing the paper. When, for instance, phenolic resin is used for surfacing, a urea resin glue line in plywood very definitely tends to break down in a curing cycle where 300° F. or more of heat is used. It does not break down at the lower curing temperatures required for melamine surface resin. Consequently, plywood which is to be surfaced with a phenolic paper-plastic material should be made with a phenolic resin glue line. For opaque surfacing, a smooth finish on the material to be surfaced is not necessary, although there should not be any sizable holes, cracks or other such imperfections present. Such defects may, however, be filled by various means. For transparent surfacing a smooth finish is highly desirable, but usually a single sanding is adequate. Because of the relatively low pressure used for opaque surfacing, either hard or soft wood, or a combination of the two, may be used. For transparent surfacing, however, a plywood panel made entirely of hard wood is preferable. Good results have nevertheless been obtained with a 100 percent soft wood panel or with a combination hard and soft wood panel.

The impregnated paper should be of the proper resin content for the results desired. For transparent surfacing, a resin content in the range of 55 percent is necessary. For opaque surfacing, however, resin contents as low as 10 to 15 percent have been used, but under such circumstances it is also necessary to use an additional amount of resin as a glue line between the paper and the material to be surfaced. Self-bonding without an additional glue line begins to occur when the resin content in the paper reaches approximately 35 percent. For best opacity a minimum resin content is desirable, but it must be borne in mind, as stated earlier in the article, that while low resin content gives better opacity, it also decreases the resistance of the material to attack by moisture and other outside influences. And the impregnated papers should have as low a volatile as possible without causing brittleness or hardness. Obviously, surfacing paper which has either of those characteristics will be very difficult to handle in production. Conversely, however, if the paper has too much volatile the curing cycle will be unnecessarily long and the danger of blistering is enhanced.

Cauls

When using paper-plastic surfacing, it is important to remember that the surface of the metal which is applied to the material will be accurately reproduced on the surface of the finished panel. Cauls of some kind are, therefore, necessary. If a high gloss finish is desired, a highly polished metal caul must be used. A low finished caul will produce a low finished panel. If a design of some kind is desired in the finished panel, an etched caul may be used. Or a piece of fabric may be inserted between the caul and the panel, the design of which will then be transferred accurately to the paper-plastic surfacing. Where a medium to high finish is to be produced, the cauls should be lubricated by means of zinc stearate powder or some other similar lubricant applied to the caul, or a lubricant may be added to the resin with which the paper is impregnated. A lubricant added to the resin does not, however, produce the highest possible finish. For such results, the application of a lubricant to the caul is recommended. Where a

design is to be embossed in the paper-plastic surface, a separator sheet such as Diafane or Cellophane should be used between etched caul or fabric and the panel.

When smooth metal cauls are used directly on the paper-plastic surfacings, the paper next to the wood conforms to any slight irregularities in the wood surface by means of both fiber and resin flow. The surface next to the caul, however, remains smooth, even giving a glass-like appearance. When using the transparentizing type surfacing, the grain of the wood shows through clearly. If, in addition to showing the wood grain, it is desirable to reproduce the various unevennesses in the grain to give the feel and texture of the wood, a sheet of Diafane or Cellophane should be inserted between the caul and the paper surfacing. This will force the paper into the wood irregularities and get away from a glass-like finish. Such a finish does nothing to impair the resistance characteristics of paper-plastic surfacing. The same is also true of the opaque surfacing but to a slightly smaller extent.

Cushioning

However accurately press plates may be aligned, there is bound to be some irregularity either in the press itself or in the materials to be pressed. Plywood and wallboard both have variations of thickness and density and so does paper. For best results, therefore, cushioning is recommended.

Usually, only one surface of either plywood or wallboard is important in an application. Under such circumstances, therefore, every care should be taken that the face surfacing is the best that can be achieved, even though the back surface may suffer somewhat as a result. A cushioning mat can be used between the press plate and the caul (both top and bottom) to give improved results. The best practice is to have the face cushion between the press plate and the caul and the back cushion between the caul and the paper-plastic surfacing, with a separator sheet of Diafane or Cellophane. The cushioning material may either be a rubber mat, a piece of thick felt or a heavy piece of canvas or webbing.

The effect of this cushioning is to equalize high and low areas as well as areas of high and low density in the materials to be pressed. Often, an unsuccessful pressing job without cushions can be made successfully with them. Naturally, the greater variation there is in the press and in the material, the greater the amount of cushioning that is needed.

Paper plastics applied as described above will result in a hard, highly abrasive resistant surface impervious to oil, gasoline and alcohol with extremely low water absorption. It is also heat and flame resistant. Purely as a surface it may be termed cigarette-proof although the heat of a burning cigarette or cigar will be transferred through it to the wood or wallboard core causing discoloration but without damage to the surface itself. This is particularly true of plywood. Some fiber boards either do not char or they dissipate heat so rapidly that charring is avoided.

In handling materials surfaced with the types of paper plastics discussed, machining of all kinds is possible as long as the general rules for machining phenolic laminates are adhered to. Such equipment should be high speed and fine cutting. Nailing is entirely feasible, but it is recommended that drilling precede the use of screws. The opaque surfacings are paintable providing the original finish is not highly polished and a type of paint compatible with the resin is used.

PLASTICS ARE CONTINUING TO BEAT A path into the home. There is scarcely a nook or cranny that hasn't been invaded. Now, plastics are consolidating their place as lamp shade fabric.

Using the low pressure molding methods, Impression Molding Inc. has developed such a fabric —Clairene—which possesses high light transmission properties and is easily cleaned with soap and water. The shade covering is composed of a glass fiber base, bonded and surfaced with an unsaturated polyester resin—Thalid.

An outstanding advantage of the Clairene shade lies in the fact that its ability to transmit a maximum amount of light makes possible the use of lower wattage bulbs. The fabric also diffuses light uniformly eliminating hot spots.

Clairene is supplied in a soft off-white which gives a bright though easy-on-the-eyes light, or it may be obtained in colors.

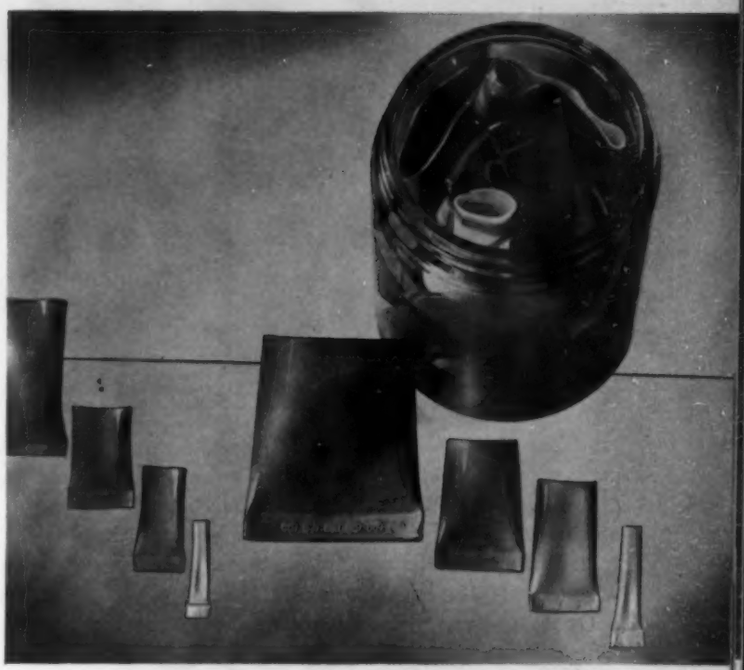
A multi-purpose protective covering

SEALING caps, sleeves and tubing of vinyl material, which can be shrunk over the ends of such industrial products as tubing, threaded pipes and precision surfaces as a protective covering are rapidly finding their way into shipping, storage, plating, painting and fabricating operations. Developed by the Plastics Div. of the General Electric Co., these coverings are tough, durable, highly moisture and chemical resistant.

The applications of this plastic material are wide. It can also be used as covering for cable ends, busbars, connectors, grips for pliers, wrenches and wirecutters for insulating purposes.

Processing calls for the use of a special dilator solution in which the vinyl tubes or caps are immersed for a period of two to four hours. This expands the material as much as half again its normal size and permits rapid use on an assembly line. While dilated, the unit is placed in position on the product and allowed to dry at room temperature or in oven heat. It soon shrinks to smaller than its original size. Fully dried, the material provides a tough, durable and hard surface which has excellent abrasion resistance. Its tensile strength is 2000 to 4000 p.s.i.

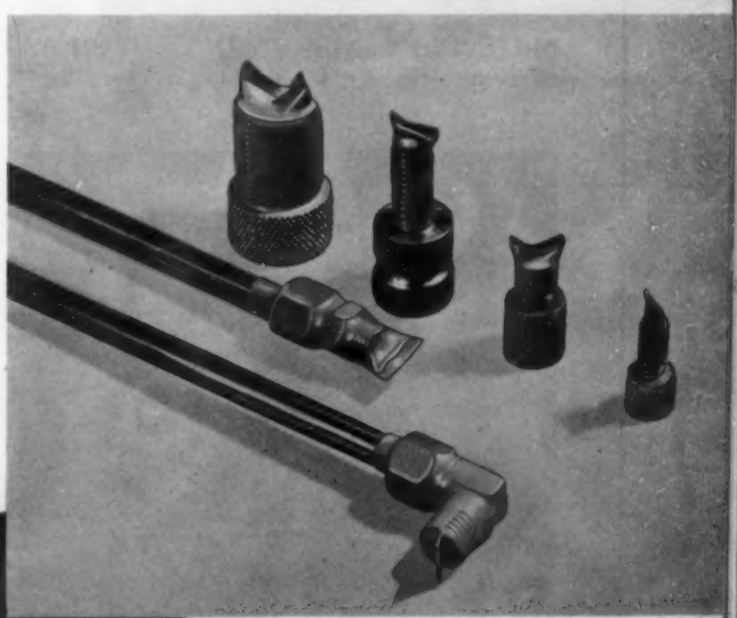
At the present time, caps, sleeves and tubing are available in any desired length and in diameters up to an inch. However, because of their stretching qualities while dilated, they may be used on tools up to 2 in. in diameter. With this process, the need for special stretching tools is eliminated.



Above—Caps and sleeves are placed in special dilator solution. They are pictured here before and after dilation

What the caps and tubes withstand

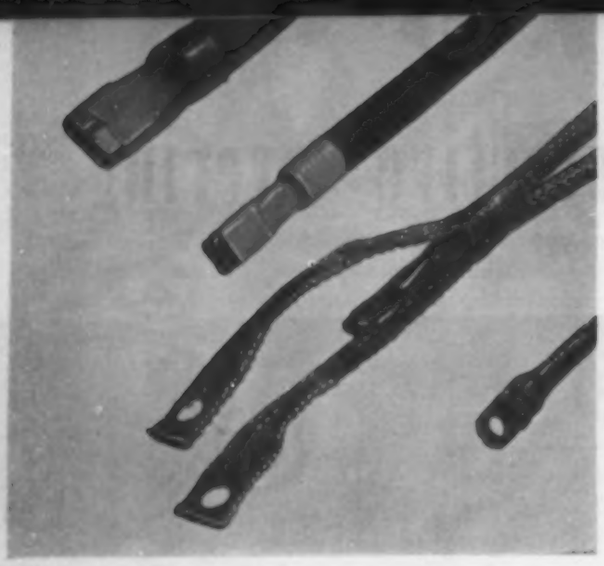
Protection, of course, varies according to the application. In covering the ends of tubing used in the manufacture of refrigerator evaporators, the vinyl cap prevents dust and moisture from entering the tubing during assembling operations. For threaded parts, the covering protects the threads from being damaged by



Above—Caps are shrunk over ends of threaded pipes for protection in shipment, storage, fabricating, painting and plating operations

Below—Tough and durable, this material can serve as an electric insulator on the grips of pliers, wrenches, etc.

ALL PHOTOS, COURTESY PLASTICS DIV., GENERAL ELECTRIC CO.



Above—Plastic sleeves keep dust and moisture from entering exposed cables during assembling operations. They can easily be removed at any time by cutting with knife

contact with other materials. As a covering for drills and other tools, it may well be used to replace grease and prevent rust and corrosions as well as protect the tools from possible contact damage. On pliers and wire-cutters, the covering is an insulator.

One of the important advantages of the product is its long life during storage. It is not affected by commonly encountered alkalis, acids and solvents, Only a very few chemicals—among them, hot oxidizing acids, cyclic ketones and chlorinated aromatic hydrocarbons—have any effect. Even when the interior of tubing or an assembled unit contains silica gel or other hygroscopic agents, there is negligible passage of water vapor through the cap or sleeve during the time protection is required. The vinyl material is also unaffected by boiling water or sterilizing techniques.

When installed, caps, tubing and sleeves can pass through conventional high-temperature baking cycles without suffering any serious reduction in strength or moisture resistance. Even after 2 hr. at 300° F., they have shown no tendency to fuse on the metal tubing with which they are in contact and can still be easily stripped from the part. The vinyl material also possesses excellent electrical properties.

Inherent and surface color

Available in black, white, yellow, green, blue, red, orange and transparent formulations, the caps, sleeves and tubing can be given color codes for identification purposes. Proposed applications call for printing directly upon them and this possibility is being investigated by the engineering development group. Caps and sleeves can be easily removed with a sharp knife. They are shipped dry and, according to company engineers, there is no necessity for storing in any particular way. It may be better to preserve them in sealed containers until used in the dilator solution but actually they can be left in or out of the dilator indefinitely.

BELIEVING THAT NOTHING CAN SHOW off plastic articles quite like plastics themselves,

Prolon Plastics Div. of Pro-phy-lac-tic Brush Co. has brought out a 5-piece all-plastic counter merchandising unit for displaying its line of all-plastic toothbrushes.

Employing not one, but three different kinds of plastics in its construction, the unit comprises a black base compression molded from general purpose phenolic, a molded white melamine shelf and three corner posts extruded from white cellulose acetate which serve to fasten the base and the shelf together.

Cavities molded into the base correspond to openings in the upper section providing a secure holder for three dozen toothbrushes. For the convenience of the customer wishing a view of all the brushes displayed before making his selection, the unit is designed so that it revolves easily. Quite logically, the revolving display is called the Whirligig.

Not least among the attributes of this display piece is its compactness in size, a feature which druggists, who are beset with counter space difficulties, can well appreciate.

Building in miniature with vinyl blocks

PHOTOS, COURTESY, DU PAGE PLASTICS CO.

THE housing shortage—in miniature at least—is over with the introduction of a building set in plastic conceived by Emil Ibach, with the assistance of A. Kip Livingston, partners in the Du Page Plastics Company. The formability of plastics makes possible production, at a reasonable price, of miniature building materials that can simulate the real thing, yet are cored so they can be mounted securely on uprights and designed with interlocking sections so they will stay in position. At the same time, they are light in weight, yet strong enough to support the weight of an adult.

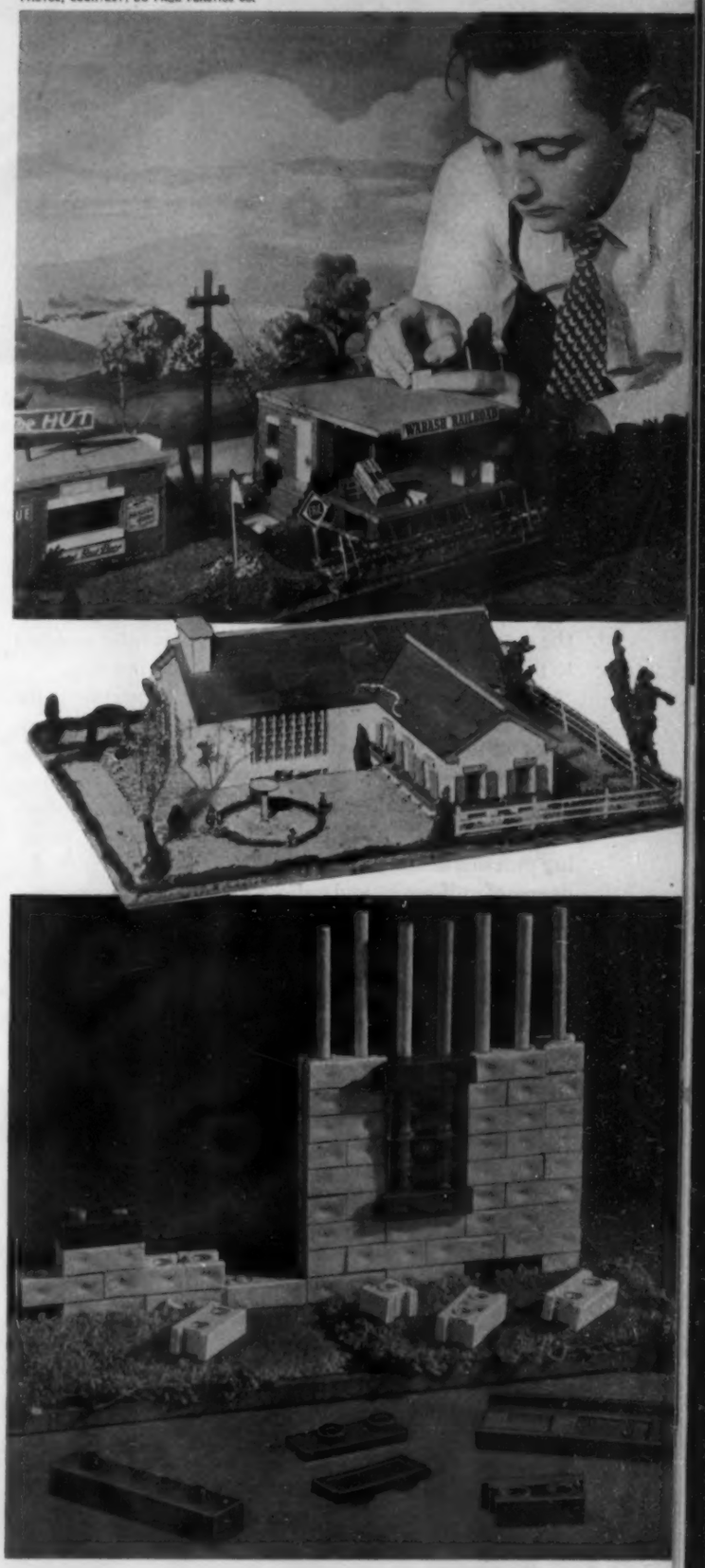
At present, the building sets come in 10 different sizes that contain from 400 to 3500 individual pieces and vary in price from $4 to $27.50. There are 24 basic plastic pieces in the sets, all injection molded of Vinylite. All building parts are scaled a quarter inch to the foot.

Basic components of these sets consist of tiny plastic bricks and little sticks or dowels, of wood. Dowels are inserted in a perforated baseboard, the plastic bricks are slipped over the dowels, the roof is added and presto—the builder has a Cape Cod house, a church, a factory or another of 30 possible structures. Blueprints are provided with each building as well as necessary accessories such as windows, doors, panels, roofing, window shutters, flower boxes and imitation glass bricks. The Vinylite comes in red, white, blue and in green.

To children these sets bring a modern fairyland of plastic homes and tiny shops, churches and public buildings, theaters and super markets, parking stations, hamburger stands, fire houses, etc. But besides being an intriguing and creative toy, many practical applications for the sets can be found in industrial, home and community planning.

More serious-minded adults can transform an architect's plans into miniature reality and work out an ideal house or plant in accurate spatial dimensions. And the table top photographer, by sprinkling soap flakes or artificial snow, can add winter to his repertoire of photographic mock-ups.

Everyday household articles can be used for landscaping. Toweling dyed green becomes a close cropped lawn, sandpaper makes neat sidewalks, a concave button from the sewing basket is turned into a birdbath, a sponge dyed green and trimmed with scissors is transformed into hedges and shrubbery, broken-off twigs grow into oak trees while labels from cans or magazine advertisements become colorful billboards.



A whistle stop (top) for the hobbyist, and family dream house (center) are applications of new vinyl building sets. Lower picture shows house going up. In foreground are door, doorstep, window box, basement window, bricks

Wartime production

By applying to a syphon head the molding technique used for the M-52 fuze, molding time has been reduced, the quality of the phenolic part improved

OF the many lessons learned during the war years by the plastics industry those relating to the molding of the M-52 trench mortar fuze may perhaps have the greatest effect on peacetime production—specially of articles like the soda water syphon head.

The complicated internal mechanism of the fuze, the fragile pin members, which projected almost throughout the entire body of the cavity, called for transfer molding to protect those parts from breakages and bending.

The insatiable demands of the War Department for speed and production in turn accelerated the development of numerous devices to cut seconds and minutes from the molding cycles. Each molder of the fuze adopted his own nostrum to solve his particular production bottleneck. By the end of the war, however, molding practice in the production of the fuze had achieved a degree of uniformity and today we are watching consumer items reaping the benefit of wartime improvisations.

To cite only a few examples of such wartime developments: bench pin-sorting fixtures, either cold or heated; automatic disassembly machines for removing pins from molded parts; pneumatic screw drivers for the same purpose; conversion to semi-automatic transfer molding; preheating of mold inserts and core pins; and lastly, though the war cannot claim all the credit for this, the advanced preheating of phenolic preforms.

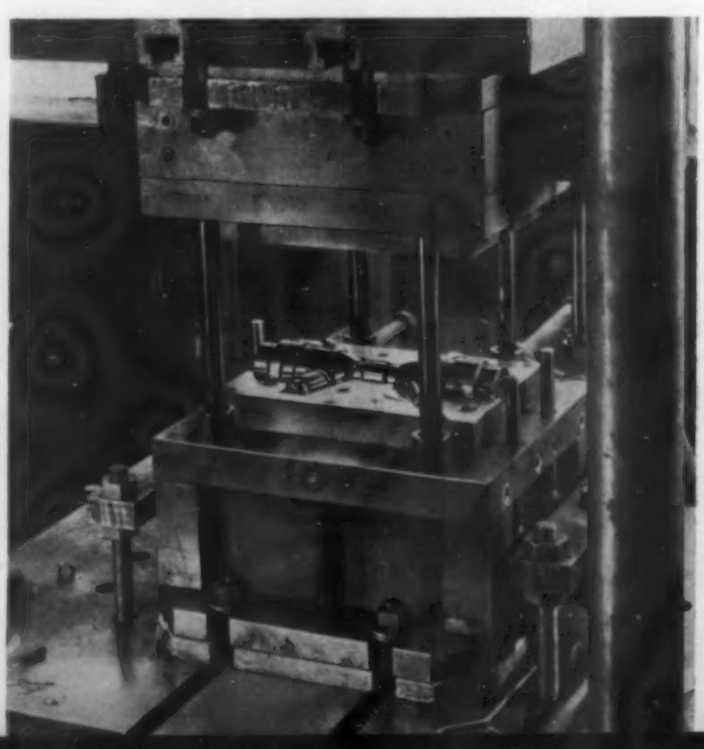
The conversion of a method

A practical instance of the value of some of these devices to a peacetime product is now to be seen at the plant of the Shaw Insulator Co., where a familiar product like a soda water syphon head, because it presents the molder with some of the same problems as the M-52 fuze, is benefiting from that company's experience with the fuze. It is interesting to note that just as wartime experience with the M-52 fuze enabled the company to improve on the molding technique used for the syphon head, so the company's work on the fuze was predicated on previous experience with the syphon.

Back in the middle and late thirties, the company was producing soda syphon heads for the Kidde Manufacturing Co., Inc. They were using hand-operated transfer presses and 4-cavity molds. Each mold demanded two operators; the complete cycle lasted about 6 min.

Today the company has cut the curing time to $1^1/_4$ min. and the cycle to $2^1/_2$ minutes. Even reckoning with the fact that today 2-cavity molds are being employed in place of those with 4 cavities, this reduction of molding and cure time represents a saving of at least a minute on the cycle, supposing only one press to be in operation. Actually the company has turned over two presses to this product. So, when the added advantages of diminished strain on operators, reduced mold abuse and superior quality and finish of the molding are taken into consideration, the new methods represent a considerable advance on pre-war procedure.

A view of the two syphon heads lying in their twin cavities after the mold has been opened. Movable parts of the mold as well as the core pins are still in position



short-cuts speed civilian goods

The design of the soda water syphon head has not been altered during its years of enforced retirement. Before the war it demanded the same number of movable mold parts and core pins as it does now. It still has one molded-in metal insert, 2 molded internal threads. In fact, the same cavities are being used. But the company has effected the improved appearance and the accelerated output by improved mold design, improved preheating and by conversion from hand-operated molds to semi-automatic molding.

Three points of improvement

To take these improvements in that order, there is, first, the mold design. By switching from a 4-cavity mold to a 2-cavity mold the company has been able to reduce the gating on each part, with improved appearance, a saving in finishing and an economy in material. The mounting of the cavities has been rearranged, an internal transfer chamber added in the press, and the mold disassembly operations performed by the press and an overhead air cylinder.

Secondly, take the matter of preheating. Today it is not just the preformed material that is preheated. All the core pins and the inserts for each cavity are individually heated in a steam-heated oven plate with special slots and holes to take each piece. Parallel with this development the company has made duplicate sets of these movable parts and pins, so that the single operator of the press can take full advantage of the dead time in the cycle.

Some of these pins he pulls out of the molded part, some he can unscrew by hand. The smallest threaded plug the operator unscrews on a pneumatic screw driver. As each comes free from the molded part it is placed in its own slot in the heated oven plate, which stands alongside the press. The inserts too are placed in this oven to bring them up to mold temperature.

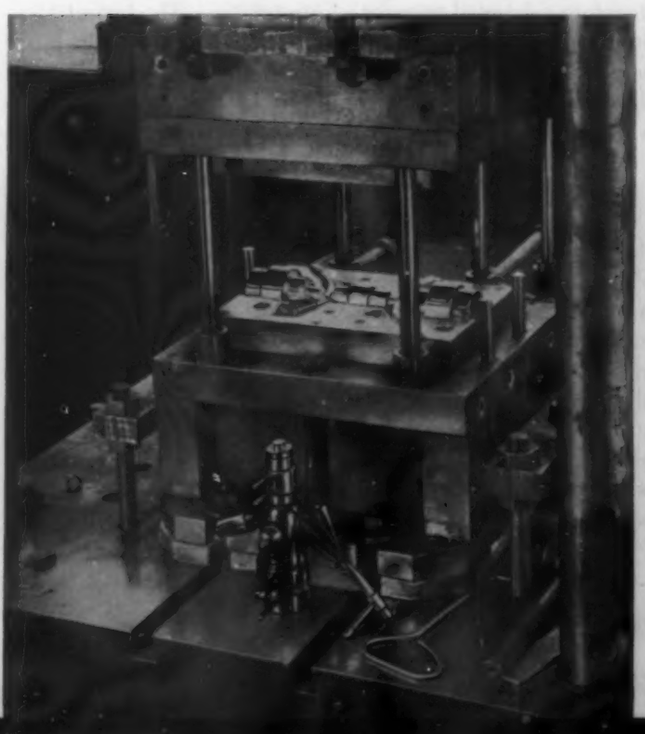
This preheating of the core pins possesses two advantages. Were the pins and inserts to be cold, the transfer time would be lengthened and material density less uniform. To avoid this, either the pins must be heated slowly in the mold or heated independently outside the mold and then loaded hot. By adopting the latter course, the molding company not only ensures uniformity of diversity but secures also a saving of the time formerly lost while the cold pins were heated in the mold.

Before the war, the phenolic preforms were not preheated but merely warmed. Today, using an Airtronic preheater, the molding cycle is further reduced.

At this point we come to the third improvement that has made for the increased and more efficient output of this soda syphon head. The mold today is semi-automatic, not hand-operated. One operation sets the whole cycle of closing and opening the press in motion.

For this job the company is using 2498 Bakelite phenolic molding powder.

The finished syphon head is shown in the foreground before disassembly of core pins and movable parts. The parts and pins are then placed in cavities for next cycle



An operator disassembles mold parts, placing each core pin back in the slotted oven plate. Here a small threaded plug is being unscrewed with a pneumatic screw driver

ALL PHOTOS, COURTESY ROHM & HAAS CO.

The world's largest "bubble," 11 ft. in diameter and formed of acrylic, is part of an outdoor display

A mammoth acrylic display dome

THE world's largest transparent "bubble," made of Plexiglas, has recently been completed by the E. L. Cournand Co. after four months of intensive experimenting and engineering. Measuring almost 11 ft. in diameter and 4½ ft. deep, the mammoth dome, estimated to have cost over 10,000 dollars to fabricate, was designed by Edward H. Burdick Associates for an outdoor advertising display recently erected for the Ford Motor Company. The giant dome will be mounted on an outdoor "spectacular" in downtown Detroit, built by the Diorama Corporation of America. Carrying out the current Ford slogan "There's a Ford in Your Future," the bubble will enclose an attractive miniature rural scene.

The crystal-clear dome, which is not quite as deep as a hemisphere, was made by drawing a heated acrylic sheet into a vacuum pot to the desired shape and allowing the sheet to cool in the drawn shape. Since the technique for forming the dome was well established, the major problem was obtaining a large enough acrylic sheet—132-in. sq. sheeting being well beyond the present production limitations of the material manufacturer. It was therefore necessary to join several sheets with a bond strong enough to withstand the vacuum used to form the dome and, more important, the stretching involved in the forming operation. In addition, the joints were to be as inconspicuous as possible.

Joining the acrylic sheets

Among the first methods tried was heat-welding, for this method promised to be quick and inexpensive. This sheet, however, fractured because of excessive stretching during forming. Cementing in a conventional butt joint had previously failed, so various other types of joint were tried—matching concave and convex V-grooves, reinforcing ribs and many others.

The final, successful method was evolved jointly by L. J. Edwards, in charge of E. L. Cournand's new product development, and Walter Speck of the Rohm & Haas technical service staff. It consisted of routing a concave V-groove in both edges of the acrylic sheets to be joined, soaking a cast acrylic rod in monomeric methacrylate cement, and placing the softened rod between the grooved acrylic edges.

When the sheets were brought together under pressure, the rods served to keep the edges in proper alignment. Ultraviolet and infrared lamps were placed above and below the joints to convert the monomer cement to solid acrylic. These lamps also hastened the drying of the joint.

As important as the joints themselves, however, was the position of these joints on the final, assembled sheet. One reason for the failure of some of the earlier joints was that they were in the center of the sheet and therefore subjected to greatest stretching. The layout finally used, a recommendation of the material company's technical service staff, called for two pieces in the center, two more in the middle of both sides forming wings, and smaller pieces completing the corners.

A special oven for forming

For forming the oversized sheet, the fabricator constructed a special vacuum pot of ¼-in. steel ship plate, 12 ft. sq. and 6 ft. high. Instead of building a special oven, the pot was insulated with a 2 in. layer of rock wool blocks and asbestos, and the acrylic heated in position by 9 electric heating elements placed radially around the tank bottom and one heating ring around the top. Air jets were installed to cool the plastic sheet slowly after forming and the vacuum air outlet centered in the tank bottom. A central control panel for the unit, with three temperature indicators,

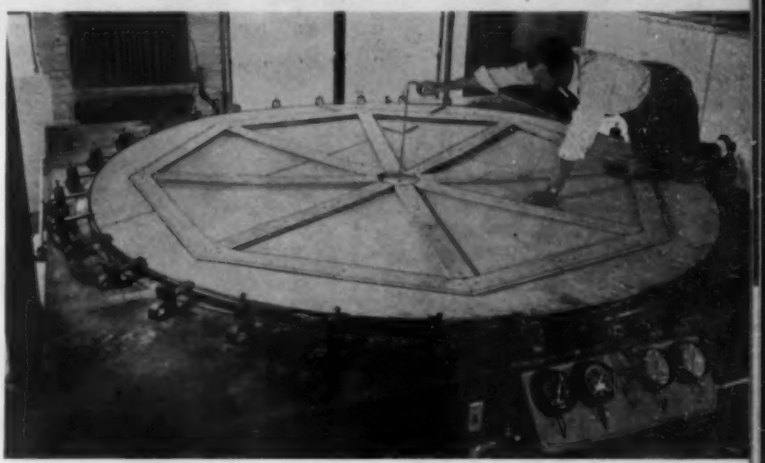
Large flat acrylic sheets, used to form the bubble, are laid on a huge table. Before they are joined, measurements of sheets and space between them are carefully checked

Sheets are drawn in a 6 ft. high vacuum tank. Here an inspector connects top circular heating element which, with 9 other units, heats sheets to drawing temperature

vacuum pressure control and dial, air inlet and heating switch, completed the apparatus used for heating and forming.

The actual forming process required 3 hr.—1 hr. for heating the acrylic to drawing temperature, 45 min. for the actual draw, and 1 hr. and 15 min. for cooling the drawn shape. After cooling, the dome was removed and the joints polished to final transparency. Then the hemisphere was mounted in a steel ring—its support for the exterior display. This specially designed, 11-ft. steel ring allows for the expansion and contraction of acrylic between extremely hot and cold weather, an especially important consideration in a unit of this size.

For shipment to Detroit, the dome was first covered with an antistatic wax to prevent dust accumulation from static electricity. A protective coating was then sprayed over the surface and the whole unit placed in a wooden crate with a spring-mounted bottom. Shipment was by rail flatcar with coil springs installed beneath the crate as an extra shipping precaution. The car had to be specially routed to permit passage of the dome under low viaducts.



Depth measurements are taken of the drawn acrylic sheet. Drawing tank has already been covered with a plywood lid

The dome, weighing over 300 lb., is removed from the tank for polishing. After being mounted in a steel ring, it is covered with a wax to prevent the accumulation of dust

After the final draw, the concave form is inspected for construction flaws. The unique circular heating element can be seen through the acrylic dome that awaits removal

PHOTOS, COURTESY THE MENGEL CO. INC.

Modern furniture uses plastics

Flexible furniture units covered with resin-bonded veneers use an acetate plug to close assembly holes

THE exigencies of modern living, particularly among young couples trying to find permanent quarters in which to start their first home, call for furniture that is rugged and versatile. One answer to this problem is Module furniture, recently introduced by the Mengel Co., Inc. Developed over a period of nine years by Morris Sanders, architect-designer, this furniture depends on plastics for its sturdiness and versatility.

Synthetic resins bond the surface veneers to give a permanent and stable finish. Synthetic resins render the adhesive, holding the component parts of each unit together, proof against attacks by moisture and extremes of temperature. Permanizing is the name that Mengel has given to this process for prolonging the life of its furniture. And a unique molded cellulose acetate plug fills holes left in the sides of furniture units for assembly purposes—holes must be concealed when a side is left exposed and is not joined to another unit.

The principle of Module furniture is simple. The Module unit is 6 inches, and cases, bases, doors, drawers, tops, legs, shelves and spacers are all designed in multiples of the Module (6 inches). The proportions vary in ratio. Cases are 36 by 18 by 18 in., 36 by 18 by 12 in., 36 by 24 by 12 in., 18 by 18 by 18 in. and 36 by 18 by 6 inches. This standard form and proportion provides for the use of cases with or without sliding glass doors and drawers, placed horizontally or vertically.

The flexibility of the units in use is made possible by a number of small accessories: the Module drawer guide, the glass door slides, the hinge and the plugs. These latter are the key to assembling by customers, since with them cases can sit upon one another, beside one another, be cantilevered, hung from the wall or ceiling and used to produce thousands of different pieces of furniture.

Two inches in from every corner and in the exact center of the long sides of each case appear small holes. These holes are the bolting points of the units. And the tool which performs the bolting is an aluminum plug, $1^1/_2$ in. in total length, one part of which is screwed into the other with the use of a penny or a dime.

Naturally, when a hole is not used as a point of connection between sections, it must be plugged. And here Lumarith comes into play in a $^3/_4$-in. plug, friction fit, molded by Waterbury Companies, Inc. The material was chosen because of its toughness, and its color was specially formulated to match the natural mahogany in which Module furniture is produced.

PLASTICS *Products*

Slicing a pie and lifting it onto a plate is simplified by Kut-N-Serve, made by Drake Products, Inc. Catalin handles are supplied by Unique Plastics Novelty Mfg. Co.

Worth taking a chance on—a cigarette box fabricated of Mottle-tone acrylic sheet by Atlas Art Products Co. Handle is clear acrylic

HOME UTILITY

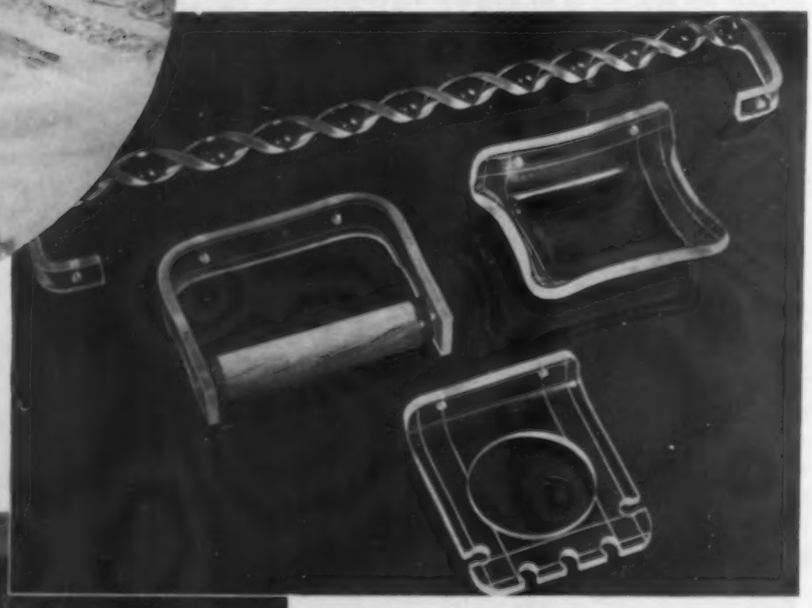
Those washday blues are sent scurrying by Chemclad, a new plastic clothesline. The Carolina Industrial Plastics Corp. puts out this Geon coated clothesline

Upholstered in durable color-fast Terson, these chairs are part of a group called Modernmates manufactured by Conant Ball Company. They come in brushed birch finish

HOME UTILITY

If your mailman doesn't ring twice he can leave letters in a box which protects them from the weather. Celomat Corp. forms pieces of the Lucite or Plexiglas box in a hydraulic press, cementing them later. The mailbox comes in red, blue, green, clear. Chelton, Inc., is the distributor of the box

A delightful spread for the festive board and a saver on laundry bills is this transparent Polythene table cloth cover made by Boland Mfg. Co. It drapes like the linen beneath it, is resistant to stains and is easily wiped clean



Something new in the usually staple bathroom fixture line has been introduced in Plexiglas by the Premier Plastic Mfg. Company

Self-sharpening on the draw, these Shur-Edge knives have the edge over others more easily dulled. Adams Plastic Co. make the case and handles of Pakkawood for Robeson Cutlery Co., Inc., laminating 0.64-in. thick strips of birch with plastic resins

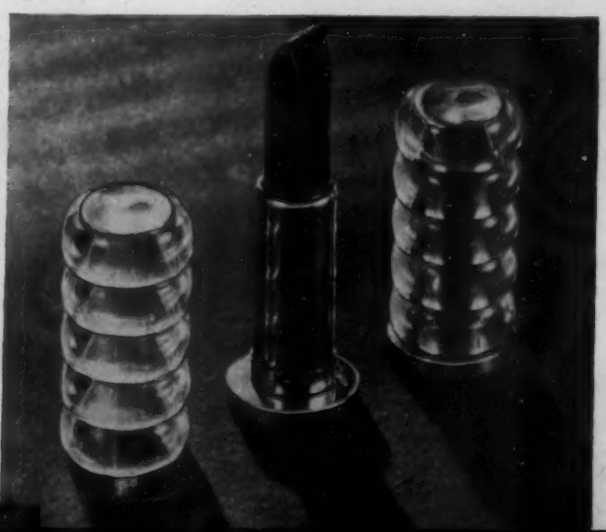
Protect your tables with "Hi-Didee, the highball diaper." Bases for the coasters are compression molded of Plaskon by Standard Plastics, Inc. Plastributors handles these red, green, blue or orange coasters which grip the glass

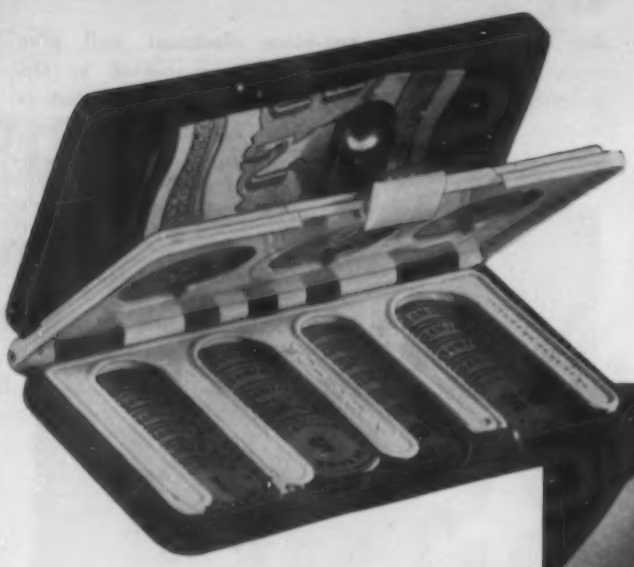
An easily installed, one-piece electrical wall plug outlet having wires mechanically connected to the molded barrel. The Receptron plug, as it is called, is molded of Resinox by Howard Manufacturing Corp.

WOMEN'S ACCESSORIES

Plenty of attention value is gained with this belt and bracelet set designed to brighten any costume. Remler Co., Ltd., molds three different colored Tenite links in five sizes for Plastic Agencies. The links are assembled with metal pins inserted through the drilled holes

Shining light—enough to snare any feminine eye is this Henry Rosenfeld lipstick case of Lucite, injection molded by Harry Broder & Co. The base is solid knurled brass with lock device that prevents screwing while lid is on

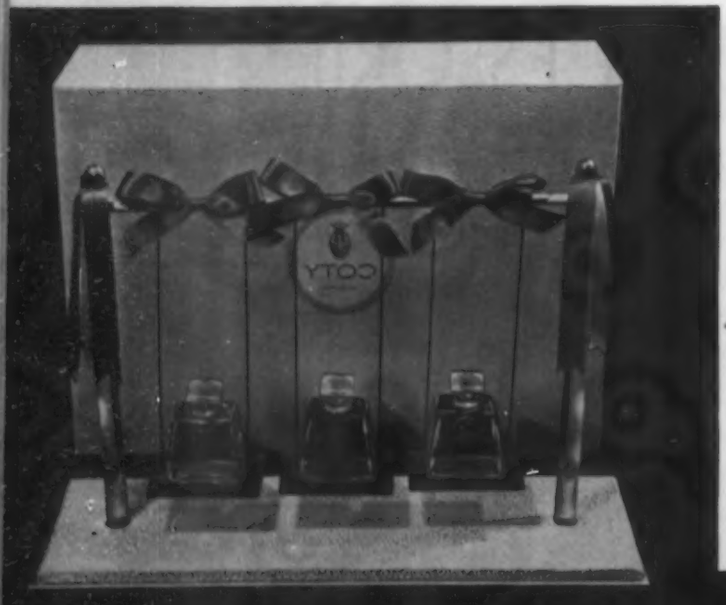




Designed for carrying one's most treasured possession. The Koinpak has compartments for every last cent and will fit compactly into women's handbags. Berens Plastics Corp. molds in one shot the 6 cellulose acetate parts which make up the change carrier

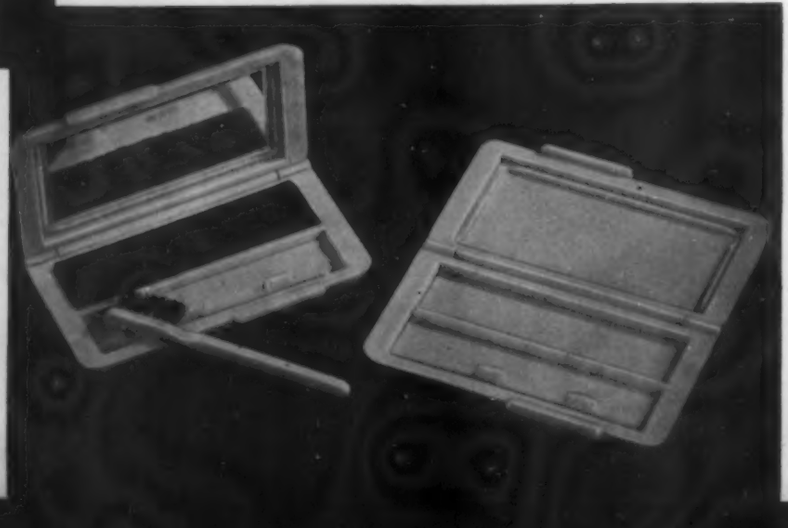
WOMEN'S ACCESSORIES

Novelty is the keynote of an Ernest Steiner cigarette case that carries cigarettes in individual compartments. Nine Lucite strips molded with concave sides and two acrylic end pieces are strung on a metal spring. The case can be opened between any of the 11 grooved strips to extract a smoke. Alternate clear and jewel colored sections give the case dash



Swinging to new heights of beauty and utility is this Coty perfume set. Polystyrene rods form framework, acetate cups hold bottles securely, and red, blue and green Tenite II is used for swing seats. Detroit Macoid Corp. supplies the plastic seats, the Arrow Mfg. Co. makes the set

Clean functional beauty characterizes the new Axiss mascara case, injection molded of ivory-colored polystyrene by Norton Laboratories, Inc. It can be opened with a flick of one hand, and is so durable that refills are provided



INDUSTRIAL APPLICATIONS

Chicken batteries and laying cages can be kept spick and span with the aid of a Lumite belt. Droppings are gathered on strips of paper laid on the belts and carried into waste receptacle. Because of the belt's resistance to corrosion, paper may soon be discarded entirely

Lightweight, practically unbreakable Tenite handles are used on new Quick-Wedge screw-holding screw drivers, designed for speedy setting and driving. Handles, molded by T Die Cast & Molded Products and Sunset Plastic Co. for Kedman Co., have high dielectric strength and are fluted for good grip

A 2-piece spool bobbin developed by Formica Insulation Co. for the textile industry. Bobbin heads are of laminated material whose direction is perpendicular to axis of spool. Outer barrel is of fabric base macerated material which, in curing, becomes an integral part of heads. Center member of bobbin can be of various macerated materials or a base-like wood

Operating on the principle of a resistance welder, this soldering iron is easy to hold and quick to heat up. The Consolidated Molded Products Corp. compression molds this case for the Weller Mfg. Co. of a rag content phenolic compound

Universal concern over the weather makes this quaint forecaster with its foul weather witch and fair weather children everyone's favorite. This Swiss cottage is molded in Ethocel by Elmer E. Mills Corp. for Utility Plastics Co.

THE YOUNG MARKET

A finicky eater? Serve your child's meal in one of these sturdy sets molded of Beetle and Melmac by Compression Molding Co. The unusual color mottling is achieved by mixing granular form of plastic with melamine impregnated rag material

Little women make early demands in fashion and Stancraft Co. makes an effort to fulfill their desires with these shiny and colorful purses of acetate sheeting. The lining is of flocking; mirror fits in lid

Kids love it—the Buzza electric choo choo with no place to go. Round 'n round it runs mysteriously, requiring no winding and having no wires to cause shock. The engine and track are molded of butyrate by the Universal Plastics Corp. for Tot Tested Toys

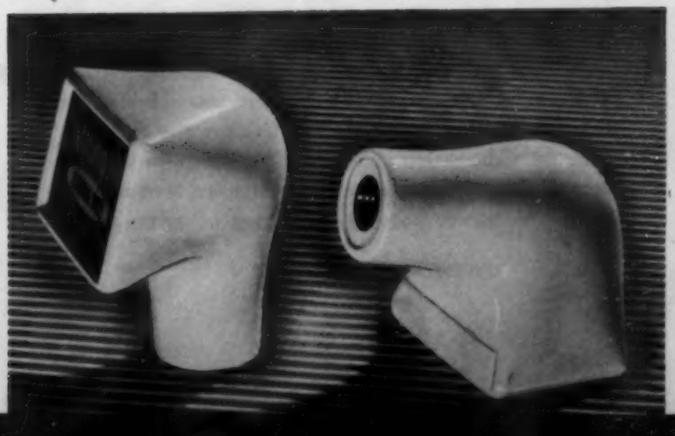
OFFICE and SHOP

That out of sight, out of mind adage is defeated by these compact Lucite units, six drawers deep. Customers can see entire stock and clerks can keep tabs on items. Charnin Builders, Inc., makes units for Merchandise Presentation, Inc.

For the man who likes to prop his feet comfortably on the office furniture, the Sikes Co., Inc., is marketing a scuff- and mar-proof chair by covering outer ends of the legs with Durez scuff plates. The B. F. Oshei Co. is the molder of these plastic plates which can take a terrific beating and have a permanent finish blending unobtrusively into the overall design of chair

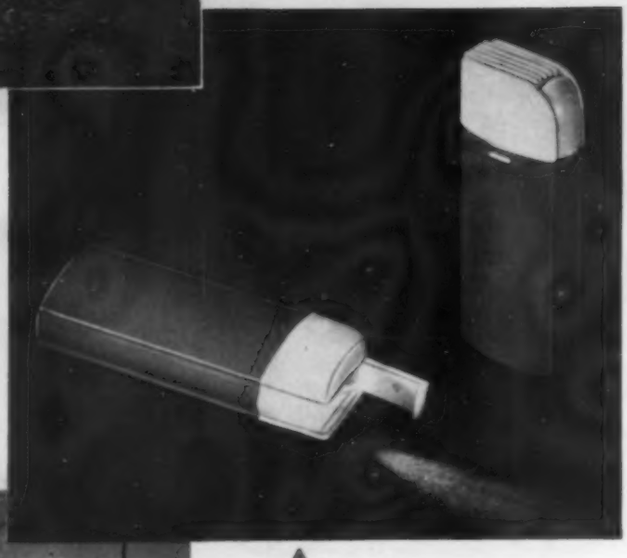
Ice and frost are conjured up any time with this Snow Queen window display—ideal for jewels and furs—put out by Zaria Display. Lumarith is used for crown and draperies. Jewels are molded by Standard Plastics Co.

The stability and low percentage of water absorption of Chemaco cellulose acetate are well adapted to this 2-piece beer dispenser knob designed by Austin & Austin and molded by Cowan & Boyden

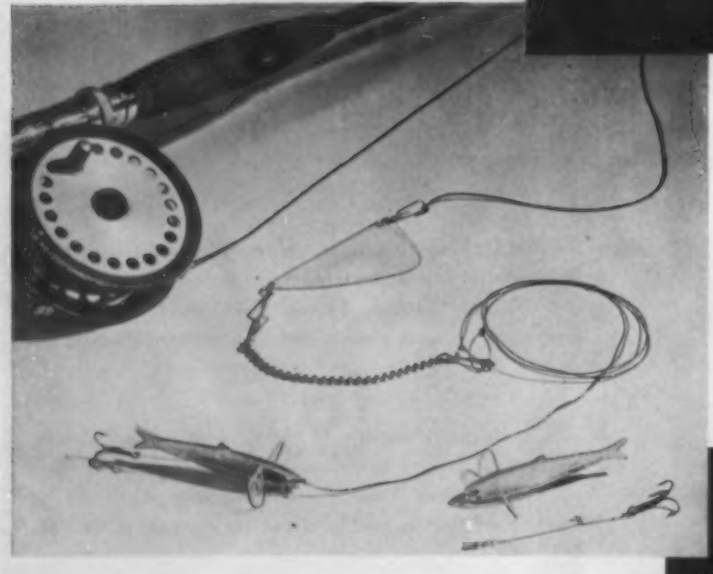


PLAYTIME PLASTICS

In the home, in the office, or at the beach, comfort-seekers will literally "float on air" with these cushions of Vinylite plastic film. Made by the DuPage Plastics Co., the cushions can be inflated to any desired degree; when deflated, can be folded to fit the pocket



A handy flashlight for those dark keyholes, by Bantam-Lite Inc., combines a metal base and 2-part translucent acetate top molded by Waterbury Companies, Inc.



A fish lure to make tall stories come true! Its Nitron form spins, but an invisible keel keeps line from twisting. Product of Fishmaster Sporting Goods Co.

Darkroom fans will welcome a new photographic tray that simplifies developing procedure. Molded of Bakelite by the W and A Tool Co. for the Intercontinental Marketing Corp., this tray permits a constant flow of clean water, in one end and out the other, to insure complete washing of prints, films

Vinyl latex coated materials, resistant to wear and moisture, have uses as raincoats, jackets, shower curtains, drapes

PHOTO AND CHARTS, COURTESY B. F. GOODRICH CHEMICAL CO.

Coating with polyvinyl chloride latex

by M. S. MOULTON*

This article on a comparatively new coating method for applying plastic material is of particular significance. Although the use of this coating has been, up till now, somewhat limited, results have been highly satisfactory. It is possible that this method may bring about a substantial saving in processing and eliminate the hazards involved in the present widely used solvent coating method. It may also speed the day when plastics are more generally wedded to each other and used more frequently with other raw materials, such as synthetic rubber, paper, fabric and leather.

NEW developments and uses of synthetics are pacing the plastics industry in its race to fame. Many of these developments have been a result of the continuous search that is going on for substitutes. This was the case a number of years ago when polyvinyl chloride, discovered by a Frenchman in 1838, was plasticized by a researcher seeking a new synthetic rubber. Today polyvinyl chloride resins and plastics are regarded as distinctly new materials with dependable specific properties and important jobs to do in industry.

The adaptability of these resins to the solution coating of fabrics, fibers, paper and many other materials is playing an important part in the rapid growth of the plastics industry and offers a brilliant advance to the textile field. A true colloidal dispersion of vinyl chloride type polymer in water, Geon latex,[1] is of particular interest to all phases of the coating field because it eliminates the use of hazardous and expensive organic solvents. It further eliminates the need for solvent recovery equipment.

Application of latex

Geon latex has been used most extensively in the fabric coating field, with most of the products during the past three years going into military use. The military applications of coated fabrics have proved that the vinyl latex coatings meet the specifications of abrasion resistance, waterproofness and flameproofness. Due to the actual penetration of the resin into the fibers, latex methods produce coatings with better adhesion to fabrics than do other conventional coating procedures.

Latex coatings for fabrics, when compounded cor-

* Technical Service Mgr., Geon Thermoplastics, B. F. Goodrich Chemical Co.

[1] Manufactured by B. F. Goodrich Chemical Co.

rectly, give a variety of finishes from dull to glossy, and they can be made in a wide variety of colors. A beautiful mirror-like finish can be produced by a suitable pressing operation following the coating of the fabric.

Dependent upon the type of material coated, vinyl latex coated fabric can be used for applications ranging from tents and awnings of moisture, flame and wear resistance to lightweight raincoats, shower curtains and other items. Indications are that fabrics lightly impregnated with the latex have acquired shrinkproof qualities without significant loss of softness or appearance. Thus washable woolens are not an impossibility.

The impregnation and coating of threads, yarns and paper to produce a variety of properties is a field open to unlimited expansion. Threads can be impregnated to give properties of water and oil resistance as well as abrasion resistance. This type of operation is particularly adaptable to proofing the heavier type materials used in stitching leather, heavy canvas and similar materials. Coated silk, rayon, nylon, linen, cotton and Fiberglas threads can be woven into many items with characteristics such as breathing, washability, and grease or abrasion resistance.

Paper can be coated with vinyl latex to give characteristics of water- and grease-proofness and improved abrasion resistance. Washable wall paper for the home is a possibility. Grease stains, handprints and the like can be readily washed off with soap and water. An idea of the speed of latex processing can be obtained from the fact that it has been applied to paper, dried and fluxed in less than 30 sec. by passing the coated paper through a drying tunnel. The deposited film when dry was about 0.001 in. thick.

Good electrical properties, resistance to oxidation, aging and oil have resulted in the development of thin wall insulation of wire by latex processing. Latex methods give accurate concentricity of coatings for thin wall insulation which is difficult to obtain by other methods. The variety of colors obtainable makes possible ready identification of wires for radio hook-ups and communication systems. It is possible to limit the color to the skin of the insulation.

Attractive finishes in all colors can be obtained on leather by latex methods. A spread or spray coating on leather followed by press polishing operations give an ideal material for attractive leather products. Shoe uppers, leather handbags and luggage are only a few items which come to mind immediately.

Nature and properties of latex

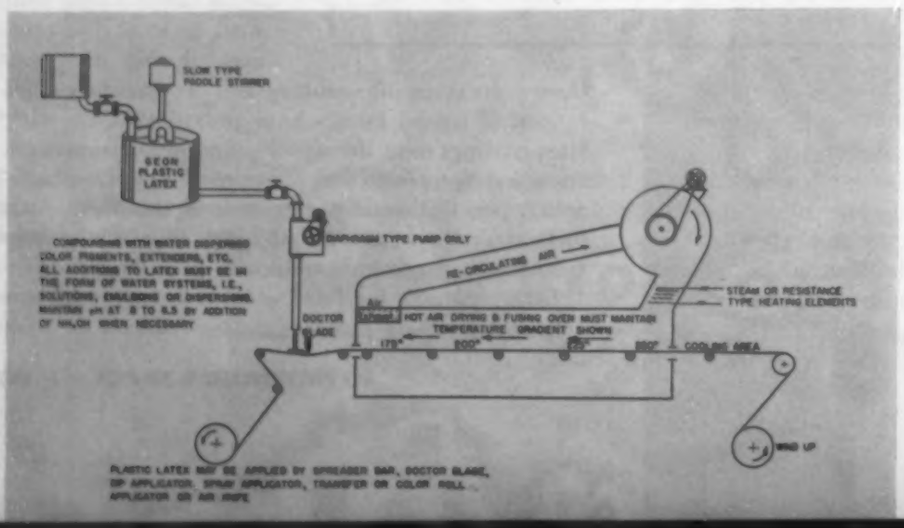
This latex is a water dispersion of very small particles of vinyl chloride type resin. Since in the manufacturing operations the transition from monomeric raw material to final product is carried out in water suspension, it is accurate to describe the system as a latex. This is a process which might be compared to the natural formation of rubber latex within the rubber tree and results in a product similar to natural rubber latex in a number of physical characteristics.

The outstanding property of the latex is its ability to form clear, coherent films on drying with application of heat. A dry, loose powder is obtained when the latex is dried at room temperature. Films formed without plasticization are brittle and tend to crack during the drying process. Hence it is necessary to add a suitable plasticizer such as dioctyl phthalate or tricresyl phosphate in sufficient quantity to achieve the desired softness and flexibility.

Since the Geon resin is thermoplastic, the particles fuse together and form a strong continuous film when the material is heated. It is known that the nature of the heat treatment, which will produce optimum properties in the film, varies with the thickness of the deposit, the amount of plasticizer and the kind of base material on which the coating is applied.

Formation and compounding

Formulation techniques with Geon latex are relatively simple. Plasticizers, extending pigments, colors and waxes usually in disperse form, are added to the latex to impart certain desired properties to the finished product. The same type of plasticizers used with dry polyvinyl resins can be used in compounding latex. The technique in the addition is the only variation. With the latex method, plasticizers are added as concentrated emulsions of the oil in the water type. Colloid mills are very efficient in the preparation of such emulsions. Extending pigments, colors and other solid materials, before being incorporated in the latex compounds, should be carefully dispersed. The higher the degree of dispersion, the more uniform and satisfactory will be the compound. Coagulation may re-


SLOW TYPE PADDLE STIRRER
GEON PLASTIC LATEX
DIAPHRAGM TYPE PUMP ONLY
COMPOUNDING WITH WATER DISPERSED COLOR PIGMENTS, EXTENDERS, ETC. ALL ADDITIONS TO LATEX MUST BE IN THE FORM OF WATER SYSTEMS, I.E., SOLUTIONS, EMULSIONS OR DISPERSIONS. MAINTAIN pH AT 8 TO 9.5 BY ADDITION OF NH4OH WHEN NECESSARY
RE-CIRCULATING AIR
STEAM OR RESISTANCE TYPE HEATING ELEMENTS
Air
Exhaust
HOT AIR DRYING & FUSING OVEN MUST MAINTAIN TEMPERATURE GRADIENT SHOWN
DOCTOR BLADE
170°
200°
250°
350°
COOLING AREA
WIND UP
PLASTIC LATEX MAY BE APPLIED BY SPREADER BAR, DOCTOR BLADE, DIP APPLICATOR, SPRAY APPLICATOR, TRANSFER OR COLOR ROLL APPLICATOR OR AIR KNIFE

This machinery set-up is for vinyl plastic latex. After coating is applied, a temperature of 200 to 250° F. is all that is needed for fusion

sult if there is a pronounced difference in particle size between the latex resins and the dispersed pigments. The solids should be slurried in water and then reduced to between 1 and 5 microns, in a pebble or colloid mill. The dispersion should be maintained slightly alkaline by the addition of ammonia or some other volatile base such as morpholine. Latex compounds generally work much better after aging for at least 24 hours.

This latex was developed primarily for the paper and fabric coating industries to provide resin in a form whose application had definite advantages over the expensive and dangerous solution coating process. When compounded with plasticizer emulsions, Geon latex provides a water dispersion system containing individual resin and plasticizer particles suspended side by side. In the application of this type of plasticized latex the water phase of the dispersion must first be evaporated, after which the deposited plasticizer particles and resin particles are fused by exposures to a temperature approximating 300° F. In applying multiple coats, the water phase must be evaporated after each application. The deposited particles of resin and plasticizer can then be joined by a final heat treatment at 300° F. temperature.

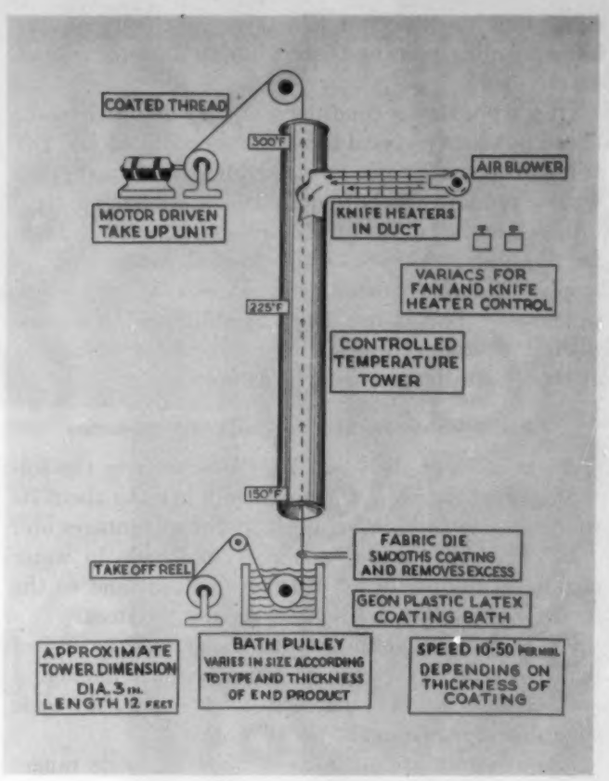
Plastic latex

Supplementing the latex just discussed, which requires the addition of plasticizer in emulsified form, is a new product called Geon plastic latex. It differs from Geon latex in that each of the units in the dispersion is a plasticized resin particle containing its own quota of resin and plasticizer. With this new plastic latex the plasticizer is added to the resin during the original manufacturing process and results in a dispersion of plasticized resin particles rather than a side-by-side formation that is obtained in emulsion compounding. These latices are also stable water dispersions maintaining a uniform particle diameter of approximately 0.25 micron. The advantage of the plastic latex lies in the fact that the compound is homogeneous and consequently the fabricator is able to lower the required fusion temperature from 300 to 250° F. and still obtain good physical properties. This reduction in final heat-treating temperature broadens the field of existing coating equipment which can be used for this work.

The plastic latices are best suited for specific operations where they can be used without further compounding. Experience has shown that plastic latices are quite suitable for general paper coating or impregnating fabrics. As with unplasticized latices, plastic latices may be further compounded with additional plasticizer (if greater flexibility is desired), extenders and color pigments. In compounding all Geon latices, the additives must be incorporated with the latex in the form of a water system, either dispersion, emulsion or solution. Varying proportions of unplasticized latex may be added to plastic latices to reduce plasticizer content.

Processing of latex compounds

In quite a number of instances, when processing materials with Geon latex, the compounds can be handled in somewhat the same manner and on the same type of processing equipment as can the solvent solutions. In the paper and fabric coating field, machines such as spread coaters, air knife machines, dip tanks, roller applicators and coating towers can be used. Compounds of either of the latices are also readily adaptable to spray technique.


COATED THREAD
300°F
AIR BLOWER
MOTOR DRIVEN TAKE UP UNIT
KNIFE HEATERS IN DUCT
VARIACS FOR FAN AND KNIFE HEATER CONTROL
225°F
CONTROLLED TEMPERATURE TOWER
150°F
FABRIC DIE SMOOTHS COATING AND REMOVES EXCESS
TAKE OFF REEL
GEON PLASTIC LATEX COATING BATH
APPROXIMATE TOWER DIMENSION DIA. 3 FT. LENGTH 12 FEET
BATH PULLEY VARIES IN SIZE ACCORDING TO TYPE AND THICKNESS OF END PRODUCT
SPEED 10-50 PER MIN. DEPENDING ON THICKNESS OF COATING

A suggested experimental coating apparatus

The coating tower method of processing has been used with great efficiency, particularly in the coating of stranded materials such as thread, yarn, string and wire. Fabrics, cords and threads of glass fiber, nylon, silk, cotton, wool and rayon have been successfully coated. The technique employed is similar to that used in ordinary fabric coating. A thin even coating of latex is applied to the material with the subsequent application of heat—for Geon latex, 300° F. and over a range of 200 to 250° F. for the plastic latex.

In laboratory coating experiments the material can be run through the heated tower at a speed ranging from 10 to 50 ft. per min., depending upon the thickness of the coating desired. With commercial applications this speed can be stepped up considerably. The controlled temperature tower causes the evaporation of water from the latex deposit at a temperature somewhat below 200° F. and allows the resin deposit to attain higher temperatures for fusion.

The principal advantage of the coating tower method over vat dipping process methods is that any number of continuous passes can be run in one operation. However, due to a high solids content in latex, care must be

taken that too heavy a film does not result in surface hardening, causing blisters due to the sealing in of water vapor.

Proper processing conditions are selected and maintained by use of physical tests on latex compounds. For example, in coating one fabric, a different viscosity and surface tension will be required of a compound than with a fabric of different texture and porosity. Tests for physical properties of the finished article are the same as for those materials processed by any other technique. This is true since it is difficult to discern whether a product was coated by the latex or solvent method, once the processing is complete.

Latex process versus solvent process

Advantages of the Geon latex process over the solvent process are many and are certain to bring about its wide usage in the coating field. Some advantages are:

1. The dispersion of the polyvinyl resin in water eliminates the use of an expensive solvent and so the need for a cumbersome solvent recovery system.
2. It further eliminates the danger in the use of highly explosive solvents which may cause damaging and expensive fires. There are, of course, no toxic fumes resulting from the use of water.
3. In vinyl latices the percentage of solids ranges from 54 to 58 percent. This compares with an approximate 20 percent solid content (at room temperature) of solvent solutions. Accordingly, the latices will give a coverage 2 to 3 times heavier than a solvent solution.
4. Vinyl resin coatings applied by latex technique possess much better adhesion to fabrics and paper than obtained by other methods.

A minor disadvantage of the water method lies in the fact that water causes shrinkage of certain fabrics. This can be avoided by use of a tenter frame. Further, a lower temperature is required in solvent process to secure continuity of resin deposit. Geon latex must be protected from freezing temperatures or coagulation will result. The containers for the latex must be lined with a non-corrosive substance, and there is a slight cost factor involved in the non-returnable containers.

Latex blends

Certain desirable effects can be obtained by blending the latex with other disperse systems. As with vinyl resins, Geon latex can be blended with latices of Hycar, to give mixtures which do not require the use of additional liquid plasticizer for a film of any particular hardness. Such mixtures also have the property of forming continuous films at substantially lower temperatures. Furthermore, the acrylonitrile type synthetic rubbers provide the opportunity for the use of vinyl resin in compositions which can be compounded to yield a plastic with thermosetting properties.

Water dispersions of certain types of acrylic resins can also be compounded with this latex. Films made from mixtures of this kind have good gloss, flexibility and heat-sealing properties. Some of the acrylic dispersions have the effect of being partial plasticizers for the vinyl resins and, therefore, permit reduced concentrations of ester type plasticizers.

A LOW POWER FACTOR WITH AN A.S.T.M. heat distortion of 105 to 113° C. and the ability to be machined to close tolerances are outstanding characteristics of Textolite 1422, a modified styrene, just announced by Plastics Divisions, General Electric Company. Because of these qualities, the material, which is a cast plastic, is expected to find use in the manufacturing of television, frequency modulation radio and radar sets, and high frequency insulation applications.

The material has a dielectric constant at 3000 MC of 2.4 to 2.5 and a power factor at 3000 MC of 0.0006 to 0.0009. Other properties, which make it applicable for certain uses where the finished product must withstand considerable wear and abuse are a specific gravity of 1.045 to 1.050, tensile strength of 8000 to 10,000 p.s.i., flexural strength of 15,000 to 18,000 p.s.i., compressive strength of 18,500 to 19,000 p.s.i., impact strength of 0.25 to 0.35 and a Rockwell hardness, H-scale, of 68 to 72.

The chemical inertness of this cast plastic make it useful for inspection windows, rollers for plating tanks or electrode supports. It is unaffected by mineral acids, alkalies, alcohols, aliphatic hydrocarbons or mineral oil. Water adsorption is less than 0.05.

PHOTOS, COURTESY M. W. KELLOGG CO.

In order that metal specimens under test can be given a polish over their entire surface, they are embedded in colored urea

Metal test specimens mounted in urea

PLASTICS are playing a new role in the laboratory. Instead of being subjects for tests, they are being used by the M. W. Kellogg Company to aid in the testing of various types of metals, the metal specimens being embedded in molded Plaskon cylinders.

In metallurgical examination work where a metal specimen is inspected under a microscope, it is important to have a flat field over the entire surface of the sample, even to the edges. This type of surfacing cannot be achieved if the test specimen is unmounted.

Why urea molding material?

With the need for mounting the metal samples established, the question was one of what type of mounting material to use. Considering the purpose for which it was to be used and the equipment available for its processing, the laboratory listed three qualities as absolutely essential to any material that could be accepted for mounting purposes.

1. An economical material. This factor is almost self-evident since the mounting is only a means to an end, not an end in itself.

2. A material that is easy to use. Obviously, a laboratory would not be justified in installing elaborate equipment or hiring a specially trained man to accomplish the mounting of their specimens.

3. A material that is available in color. This qualification needs explanation. A great many different types of steels are handled in the Kellogg Metallurgical Laboratory. So that the type of steel being tested can be identified at a glance the Laboratory wanted to use a differently colored mounting material for each type of metal. Today, for example, all plain carbon steels are embedded in black, all carbon-molybdenum steels in blue and all Pluramelt (stainless steel molecularly bonded to carbon steel) samples in red.

Balancing these three factors, the company selected Plaskon as the plastic material meeting its needs.

Mounting the specimens

The first step in a metallurgical examination is the cutting of a small "button" from the metal under test. This small specimen is then placed in a cylindrical die and the urea molding powder, in whatever color is desired, poured around it. Placed in a special laboratory press this assembly is subjected to several thousands pounds pressure and a relatively low temperature until the plastic is cured. Upon removal from the die the metallographer polishes one face of the molded urea cylinder so that the exposed end of the metal "button" will have the uniformly flat surface which is necessary for the laboratory examination.

In the above illustrations we have indicated the quick identification made possible through the use of plastic of different colors. The colors, however, are not those actually used in this work.

This is not an actual place setting but a printed advertisement impregnated with polyester resin and laminated to acrylic sheet. The piece achieves a third-dimensional effect by the use of edge lighting

New acrylic contact laminate

Fabric and paper, impregnated with polyester resin, are laminated to acrylic sheet, then post-formed

FOR a long time it has been the ambition of acrylic fabricators to achieve clever color and design application by simpler mechanical means. It has also been their hope that someone some day would develop a thermosetting material as formable as acrylic and with acrylic's light transmission properties.

One of the methods under investigation for achieving these objectives has been the lamination of a post-formable polyester impregnated fabric (containing color and design) to clear acrylic sheet. The proposition has been experimental to date. Several companies have had it as far as the pilot plant stage. But within the last few weeks it has come into regular production at the plant of Swedlow Plastics Company.

The new material can be formed with standard dies of wood, plaster, light metal or plastics normally used for forming acrylics. The only factor limiting depth of draw is the stretchability of the fabric in the polyester skin, so a forming tool is used which is equipped with a double-acting hold-down fixture, permitting the material to be stretched to the maximum while being drawn into the mold.

The lamination is made on a continuous basis and comes out of the machine ready to be formed either flat or in shapes.

Forming pressures and heats are those normally used for bending acrylic materials and are sufficient to complete the cure on the job.

Substituting paper for fabric

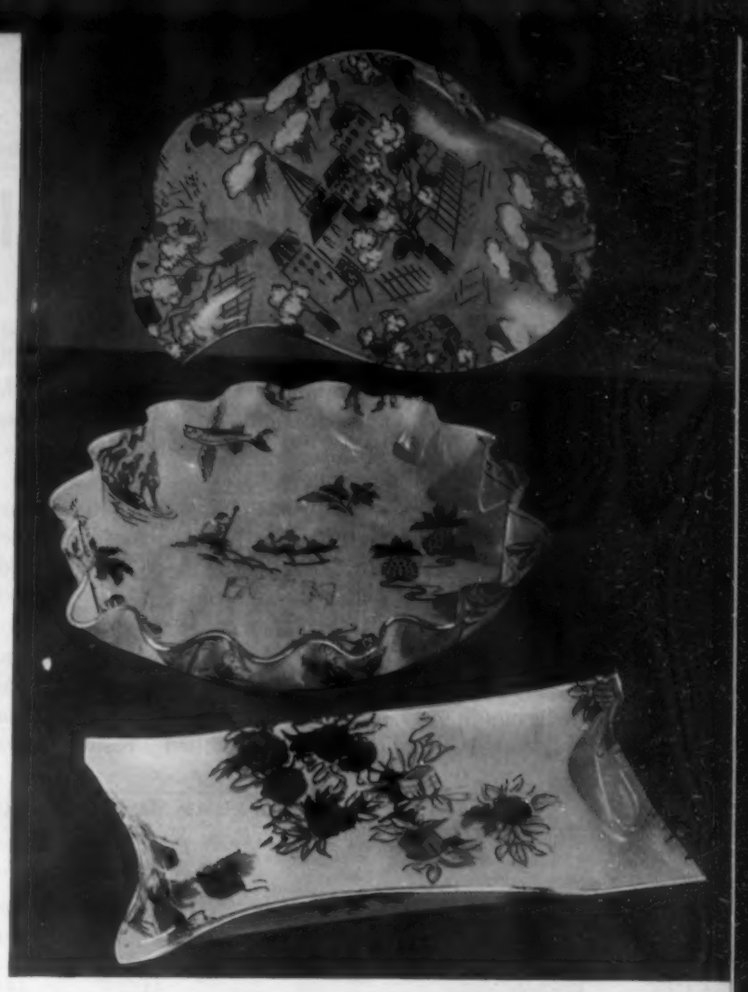
In addition to the standard material composed of a colored and designed fabric impregnated with polyester resin and laminated to perfectly clear acrylic, there are several variations possible. In the first place, polyester impregnated paper can be used instead of cloth and the resulting laminate can be fabricated flat into

advertising signs or can be bent in simple curves for various purposes. In the second place, the resin can be pigmented to give a wide variety of effects with clear acrylic. Finally, colored acrylic can be used, although no obvious advantage of this has appeared yet.

The field of application is just opening

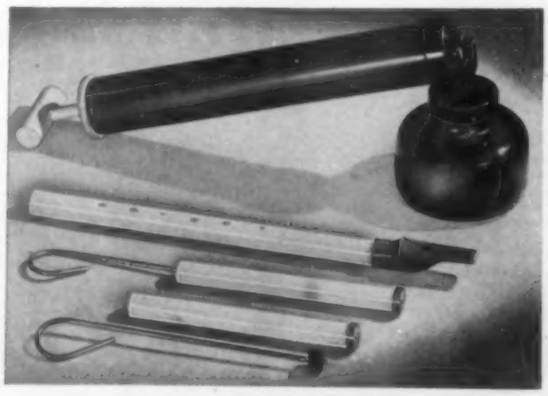
Uses for the new laminate are based on one side being thermosetting, the other side thermoplastic, on the thermoplastic side having light piping ability and on the whole being formable to close tolerances with the application of reasonably low heats and pressures. Bowls, trays and decorative utensils made with the material are less inclined to show scratching than those made of acrylics alone. The outside is hard to scratch and if the inside does get scratched, the damage is not obvious. Architectural panels, displays, signs, maps and lighting fixtures are a few other applications that come to mind. The translucency of the material can be an advantage in most cases. As with every other new development, the fabricators who will use this new laminate will think of a dozen uses for every one now projected by the supplier.

The proposition possesses many elements that may be new to most fabricators. The drawing and stretching methods have been worked out by the suppliers so that no shrink or bubbles will develop in the fabrication process. So in offering the new laminate to a restricted group of high-class fabricators, the company is willing to place its *know-how* at the disposal of these fabricators, letting them develop new products and markets. Future developments will be watched with interest.



Colorful bowls having printed fabric on their outside surface can be formed into almost any shape. Outsides of pieces are thermosetting, insides are thermoplastic

THE VERSATILITY OF EXTRUDED plastic tubing is well illustrated in three products which furnish Mother with a spray gun for insecticides, Sister with a toy flute and Junior with an efficient and surprisingly accurate water gun. The extruded parts for all three of the devices are supplied by Carter Products Corp.



The insecticide spray, produced for the American Specialty Co., has 4 plastic parts. Three of these are made of Tenite II or acetate; the fourth is of extruded Vinylite. A wooden handle and end pieces are fitted into the large paper tube which in turn fits around a ring in the injection molded head which must be held to a tolerance of 0.002 in. at the inside dimensions. Running through the head and down into the glass jar is the small extruded tube that serves to draw the insecticide from the glass container.

The Wilson Products Company's water gun is simply constructed, again using extruded tubing and molded nozzle. A felt plunger and a stiff wire supply the force by which the water is ejected.

Piper, the flute, is manufactured by Grossman Music Co. and represents an even better example of close tolerances as the injection molded acetate mouthpiece fits over the extruded tube and slides back and forth to change the pitch.

Plastics production statistics for 1945

ACCORDING to figures just released by the United States Tariff Commission, production in 1945 of all plastics materials combined was the largest on record, amounting to 808 million pounds or 26 million pounds greater than in 1944. Sales were 753 million pounds, valued at 267 million dollars.

There has been a significant change in the grouping of certain plastics materials in this report as compared with those of earlier years. Previously, unmodified rosin esters were reported with alkyd resins (oil and solid type). Production of that group was formerly by far the most important in the total of plastics materials. Despite the exclusion of unmodified rosin esters from the group in 1945, alkyd resins amounted to 188 million pounds. Production of unmodified rosin esters amounted to 66 million pounds in 1945. The output of tar acid resins including phenolic and mixed phenolic (both modified and unmodified) was 186 million pounds, slightly less than in 1944 because of the continued shortage of materials. In 1945 the output of polystyrene resins was 22 million pounds as compared with about 11 million pounds in 1944. Production of urea-melamine resins increased somewhat in 1945.

The greatest single use for plastics materials reported for 1945 was for protective coatings. Out of the total production of 808 million pounds of synthetic resins, 304 million pounds was produced for this purpose. The next largest use for plastics materials was for molding and casting, 160 million pounds being produced for this use.

Table I.—End Use Data for Plastic Materials, 1945 (Quantities and values are based on net resin content only)

Material	*Production*	*Sales*		*Unit value*	*Production*	*Sales*	
		Quantity	*Value*			*Quantity*	*Value*
	1000 lb.	*1000 lb.*	*$1000*	*per lb.*	*percent*	*percent*	*percent*
For protective coatings	304,461	269,006	61,155	0.36	37.6	35.7	26.4
For molding and casting	160,223	157,098	76,679	0.51	19.8	20.8	30.8
For laminating	44,777	44,016	12,117	0.38	5.5	5.8	5.4
For adhesives	79,025	72,927	19,341	0.26	9.8	9.7	6.9
For textile, paper and leather treatment	30,958	28,545	10,787	0.28	3.9	3.8	3.2
For miscellaneous uses	188,790	181,503	87,018	0.41	23.4	24.2	27.3
Total	807,234	753,095	267,097	0.37	100.1	100.0	100.0

Table II.—United States Production and Sales of Plasticizers, 1945

Chemical	*Production*	*Sales:*		
		Quantity	*Value*	*Unit value*
	1000 lb.	*1000 lb.*	*$1000*	*per lb.*
Grand total	169,269	139,315	33,529	$0.24
PLASTICIZERS, CYCLIC				
Total	138,955	122,560	26,892	0.22
Phosphoric acid esters: tricresyl phosphate	13,552	13,977	3,398	0.24
Phthalic acid or anhydride esters, total	98,945	87,908	18,238	0.21
Dibutyl phthalate	45,915	43,032	8,436	0.20
Diethyl phthalate	9,700	8,665	1,638	0.19
Dimethyl phthalate[a]	18,822	16,724	2,602	0.16
All other	24,508	19,487	5,562	0.29
All other cyclic plasticizers	26,458	20,675	5,256	0.25
PLASTICIZERS, ACYCLIC				
Total	30,314	16,755	6,637	0.40
Azelaic acid esters	37	31	17	0.55
Citric acid esters: triethyl citrate	539	...	...	...
Lauric acid esters	364	318	121	0.38
Oleic acid esters	3,148	820	297	0.36
Phosphoric acid esters	2,160	1,675	739	0.44
Sebacic acid esters: dibutyl sebacate	5,853	4,398	2,199	0.50
Stearic acid esters, total	3,074	2,399	862	0.36
Butyl stearate	832	659	196	0.30
Glyceryl monostearate	1,061	[b]	[b]	...
All other	1,181	1,740	666	0.38
All other acyclic plasticizers	15,139	7,114	2,402	0.34

[a] Includes dimethyl phthalate for use as an insect repellent.
[b] Included in "all other" stearic acid esters.

Table III—United States Production and Sales of Plastic Materials, 1945 (In terms of net resin content)[a]

Class and Product	Production	Sales[b]		
		Quantity	Value	Unit value
	1000 lb.	*1000 lb.*	*$1000*	*per lb.*
GRAND TOTAL	808,234	753,095	267,097	$0.35
Rosin esters, total	83,788	73,544	10,845	0.15
Rosin esters, modified:[c]				
Tar acid resins: phenolic-formaldehyde resins, rosin ester modified[d]	17,811	16,955	4,006	0.24
Rosin esters, unmodified, total	65,977	56,589	6,839	0.12
Abietic acid-glycerol	47,847	42,733	4,656	0.11
Abietic acid-pentaerythritol	12,910	9,212	1,320	0.14
Abietic acid-other polyhydric alcohols[e]	5,220	4,644	863	0.19
Tar acid resins, except rosin ester modified, total	168,690	164,922	54,372	0.33
Unmodified, total	167,120	163,393	54,084	0.33
Phenolic resins except mixed phenolics, total	125,960	124,113	44,124	0.36
Phenol-formaldehyde, total	98,812	97,988	35,775	0.37
For molding	50,081	50,208	21,783	0.43
For laminating	17,222	17,052	3,869	0.23
For protective coatings	3,530	2,995	1,352	0.45
For adhesives	14,286	14,216	3,539	0.25
For casting, for ion exchange, and for treatment of textiles, paper and leather	5,297	5,416	3,152	0.58
For miscellaneous uses	8,396	8,101	2,080	0.26
All other phenolic resins except mixed phenolics, total[f]	27,148	26,125	8,349	0.32
For molding and casting	1,925	1,870	425	0.23
For protective coatings	12,533	11,905	4,178	0.35
For adhesives	1,340	1,332	941	0.71
For other uses	11,350	11,018	2,805	0.25
Mixed phenolic resins, total[g]	41,160	39,280	9,960	0.25
For protective coatings	5,282	4,755	834	0.18
For other uses	35,878	34,525	9,126	0.26
Modified: phenol-formaldehyde[h]	1,570	1,529	288	0.19
Alkyd resins (oil and solid types), total[i]	187,870	163,867	38,595	0.24
Modified by rosin esters, total	34,931	33,579	7,207	0.21
Phthalic type:[j] for protective coatings	1,502	1,272	320	0.25
Polybasic acid types except phthalic, total	33,429	32,307	6,887	0.21
Abietic acid-maleic acid	26,732	25,376	5,573	0.22
Abietic acid-and other polybasic acids[k]	6,697	6,931	1,314	0.19
Unmodified by rosin esters, total	152,214	129,578	31,076	0.24
Phthalic type, total	132,112	110,118	25,017	0.23
Phthalic type, unmodified, total[l]	131,294	109,379	24,833	0.23
For protective coatings	130,337	108,438	24,579	0.23
For other uses	957	941	254	0.27
Phthalic type, modified by acids:[m] for protective coatings	818	739	184	0.25
Phthalic type, modified by phenol-formaldehyde	[n]	[n]	[n]	[n]
Polybasic acid types except phthalic, total	20,102	19,460	6,059	0.31
Fumaric acid	423	483	148	0.31
Maleic acid or anhydride and maleic anhydride-terpene, total	12,526	11,802	3,189	0.27
For protective coatings	8,794	8,649	1,781	0.21
For other uses	3,732	3,153	1,408	0.45
All other polybasic acid types except phthalic, total[o]	7,153	7,175	2,722	0.38
For protective coatings	7,034	7,045	2,660	0.38
For other uses	119	130	62	0.48
All other alkyd resins[p]	725	710	312	0.44
Urea and melamine resins, total	71,415	69,804	20,944	0.30
Urea resins, unmodified and modified, total	58,799	57,538	15,422	0.27
For protective coatings	5,618	4,679	1,477	0.32
For adhesives	30,414	29,787	5,813	0.20
For other uses	22,767	23,072	8,132	0.35
Melamine-formaldehyde, unmodified	10,274	10,047	4,825	0.48
Melamine-formaldehyde, modified	2,342	2,219	697	0.31
Vinyl resins, total	122,507	110,576	46,964	0.42
Vinyl alcohol, vinyl acetate and vinyl ether	27,319	20,729	9,258	0.45
Vinyl chlorides and copolymers	84,023	79,363	30,241	0.38
Vinyl formal and vinyl butyral	11,165	10,484	7,465	0.71
Styrene resins, total	22,794	22,115	6,620	0.30
Polystyrene, unmodified	22,030	21,347	6,109	0.29
Styrene copolymers	764	768	511	0.67
All other resins, total[q]	151,170	148,267	88,757	0.60
For molding and casting	21,198	20,473	22,650	1.11
For laminating	414	405	96	0.24
For protective coatings	20,343	19,392	2,625	0.14
For other uses	109,215	107,997	63,386	0.59

[a] Net resin content excludes all fillers, unreacted modifiers (such as ester gum when not chemically combined), dyes and plasticizers. Additives such as rosin (80 percent or more abietic acid) which are chemically combined with other resin-forming components are included in the data.
[b] Sales of resins for protective coatings include certain intraplant transfers as well as the usual interplant transfers.
[c] Other solid rosin ester resins, modified, are included with the alkyd resins.
[d] Include substituted and unsubstituted phenolic resins, rosin ester modified.
[e] Include abietic acid-glycol, abietic acid-other alcohols, and abietic acid-mixed alcohols (e.g., mixture of glycerol and pentaerythritol).
[f] Consist principally of substituted phenolic resins reacted with formaldehyde and in some instances with furfural.
[g] Include cresols- and xylenols-formaldehyde; cresylic acid-formaldehyde; phenols- and cresols-formaldehyde; cresols-, phenols-, and xylenols-formaldehyde; and phenols- and xylenol-formaldehyde resins.
[h] Include phenol-formaldehyde modified by terpene, aniline, rosin (abietic acid), and coumarone-indene.
[i] Include acid or anhydride-alcohol-oil chemically combined when oil modified.
[j] Consists essentially of phthalic anhydride-glycerol resin modified by rosin or further modified by phenol-formaldehyde.
[k] Include abietic acid modified with other acids, zinc or oil.
[l] Includes phthalic anhydride reacted with glycerol, glycol, pentaerythritol, mixture of alcohols, or allyl alcohol.
[m] Includes phthalic anhydride resins modified with maleic acid or anhydride, adipic, benzoic and other acids and with maleic-abietic acids.
[n] Included in all other alkyd resins, unmodified, to avoid disclosure of individual company operations.
[o] Includes adipic acid, azelaic acid, citric acid, congo ester, sebacic acid and cyclopentadiene-maleic anhydride resins.
[p] Include phthalic anhydride modified by phenol-formaldehyde and other unspecified alkyd resins.
[q] Include polyacrylic acid resins, polyacrylic acid ester resins, polymethacrylic acid ester resins, petroleum resins, polyolefin resins, furfural-acetone, toluenesulfonamide, polyamide resins, polyterpene resins, coumarone-indene and silicone resins.

Plastics Stock Molds

SHEET ONE HUNDRED FORTY-TWO

Molded tableware is available from stock molds in 32-piece sets, or individually. Colors include green, red, yellow and ivory. Baby dishes come in pink or blue, and can be sterilized. Additional information, manufacturers' names and addresses, may be obtained from Stock Mold Div., Modern Plastics, 122 E. 42nd St., New York 17, N. Y. Please state sheet and item number.

Molders and fabricators are invited to submit their samples of stock products to appear on these pages as space permits.

1678. Grill plate, with three compartments. 11 in. in diameter.

1679. Chop plate, 11¼ in. in diameter. Can be used as small serving tray.

1680. Dinner plate, 9¾ in. in diameter.

1681. Bathroom tumbler, 2½ in. at top, 2 in. at base. 3½ in. high.

1682. Cereal dish, 5½ in. in diameter.

1683. Vegetable dish or salad bowl, 8 in. in diameter.

1684. Baby training cup with removable lid which meters liquids and prevents spilling. Overall diameter 2 in. by 3 in. high.

1685. Fruit or sauce dish, 4 in. diameter.

1686. Kiddie grill plate, with three compartments. 9 in. in diameter.

1687. Salad plate. 7 in. at outside diameter.

1688. Deep-celled baby dish with three compartments. 8 in. in diameter by 1⅛ in. deep.

1689. Tapered salt and pepper shakers, 2¼ in. high by 1½ in. diameter at base. Holes for pouring form letters "S" and "P." Screw-in bottoms, ridged, non-slip sides.

Items 1–1582, which have appeared previously, are correlated in the Plastics Stock Mold Catalog, available for $5.00.

REG. U. S. PATENT OFFICE

Plastics Engineering

F. B. STANLEY, Engineering Editor

Annealing of styrene and related resins†

Failure of parts due to thermal and mechanically induced strains can be overcome through the use of one of the annealing processes discussed in this article

by JAMES BAILEY‡

THE definition of annealing has been variously stated and does not mean the same thing in all arts. In the metal industry it refers to the soft state of the material which is usually accomplished by heating it to a certain high temperature, then cooling at a slow rate, though with certain alloys a very rapid rate is required. In the glass industry there is a much closer analogy to plastics and it is worth while to review briefly some of this industry's findings.

There are two major schools of thought with regard to glass. The older and more general one defines annealing as a cooling cycle, starting at a high-temperature strain-free state, which permits the glass to reach equilibrium at room temperature with small internal strains. In the last 30 years these internal strains have been measured and defined by means of polarized light and are expressed as *birefringence* or color bands or colors as seen in the polariscope. The use of the polariscope in the glass industry is now universal, but the interpretation of the color pattern is very involved and is sometimes misleading.

According to the second and newer school of thought, annealing includes not only a condition free from mechanical strains and birefringence but a condition in which the glass is in a state of equilibrium as regards its molecular state. Rapidly chilled glass tends to partake of the molecular arrangement corresponding to its higher or melted temperature. Its density is low; its refractive index is low, etc. This is serious in optical glasses where refractive indices must be closely held. Moreover, it has been shown that some complicated optical glasses undergo a change of index of refraction with time if a rapid annealing cycle has been used even though acceptable annealing, as measured by the birefringence of the glass, has been done. Hence, the precision optical manufacturers include a satisfactory degree of stabilization as a requirement of their annealing.

History of annealing

During the first world war, Adams and Williamson[1] made a study of annealing optical glass and derived a formula for the release of strain in glass as a function of temperature. This permitted the *designing* of an annealing cycle which would permit any final desired strain to be left in the glass. They also made a study of the distribution of strains and temperature gradients in solids (round rods, slabs, cubes and spheres) and showed that the stress distribution due to uniform rates of cooling or heating were proportional to the square of the thickness.

Their cycles consisted of two major parts:

1. A holding time at a certain temperature at which the strains could relieve themselves.
2. A graduated cooling cycle starting with a very slow rate of cooling and gradually increasing this rate in accordance with the relaxation time at that temperature so as to prevent appreciable reintroduction of strain during cooling.

Having established the laws, the problem was then to design an annealing cycle having a minimum overall time consistent with the required residual strain.

Later, Dr. George V. McCauley made a study of annealing in connection with the development of the 200-in. telescope disk and derived a somewhat different and shorter curve than those of Adams and Williamson. Dr. McCauley based his cooling cycle entirely on the degree of strain introduced by the temperature distribution minus the relaxation of strain which takes place

* Reg. U. S. Patent office.

† The basic study by the Plax Corporation of the annealing of polystyrene and related resins became necessary during the early phases of the war in order that the Armed Services might obtain polystyrene parts which could be used over a long period of time without fear of failure caused by thermal and mechanically induced strain.

‡ Plax Corporation.

[1] Jour. Franklin Inst. *190*, 597–631, 835–870 (1920).

ALL PHOTOS AND CHARTS, COURTESY PLAX CORP.

1—*A kerosene test has been found to be a quick, easy and reliable means of determining whether or not annealing has been accomplished satisfactorily. This graph shows (left to right) a properly annealed sample, a borderline case where annealing is unsatisfactory and a piece which has not been annealed*

simultaneously at the temperature and time involved in the process.

Annealing plastics

While polystyrene and the acrylic resins are similar to glass in many ways, the structure is not the same. Plastics differ from glass in the respect that they have long chain molecules, those of the thermoplastic type having few if any cross links. They are not truly viscous, as is glass, even at high temperatures. But they do have a *yield point* of a sort which is another way of saying that their viscosity varies at constant temperature as some function of the speed of flow, being lower at high speeds. The apparent viscous flow over short distances is further masked by the superposition of a cold flow curve and by possible molecular breakdown in structure with time, temperature and flow. They exhibit marked orientation upon stretching with profound changes in the mechanical strength and in optical properties, which make it quite impossible to study the annealing phenomena with the polariscope.

The first requisite of any attempt to study annealing of polystyrene was some method of finding the degree of residual strain. The Plax Corporation was probably the first to do this in a simple manner by applying the kerosene test which, according to our laboratory work, indicates a stress of approximately 150 p.s.i. by causing body cracks to start around a small hole drilled into the material at or above this stress. Using the kerosene test as a strain indicator, it became a matter of study by trial and error to develop an annealing cycle for polystyrene rod (say 1 in. in diameter) and then from this to deduce other cycles for the various sizes and shapes to be manufactured.

The investigation was continued until the cycles had been reduced to a practicable basis, including proper factors of safety consistent with our tank method of annealing and other manufacturing methods.

In addition, it was shown that the problem of relieving strains in polystyrene is not to be confused with orientation nor with any considerable change in state, but is to be regarded primarily as a simple release of thermally induced strains of a nature analogous to those in glass. Thus, annealing for use with polystyrene and similar plastics as discussed in this article can be simply defined as the reduction of internal stresses from whatever cause to a point where the residual stresses after annealing can be borne safely by the material during its life without crazing or cracking. The Plax standard cycles reduce the stresses in annealed parts to less than 150 p.s.i.

As has been previously mentioned, in order to determine whether annealing as accomplished was satisfactory, it was necessary to develop a quick, easy and reliable test. We believe the kerosene test (which is described below), while possibly unnecessarily severe, serves the need quite well.

The kerosene test

The kerosene test consists of selecting a representative piece of the polystyrene material, immersing it in kerosene for 1 min. at room temperature (20° C. ± 5°), then removing it without wiping, and observing the result. If the piece is free from cracks at the end of 30 min. after its removal from the kerosene, the annealing is satisfactory. This applies only to such small pieces as will not receive or require any subsequent machining.

In the case of long rods, a crosswise sample is cut from the rod at a point distant at least 3 diameters from the nearest end and at least $^1/_4$ in. thick, measured in the direction of the original length of the rod. Four small holes are drilled through the sample in the axial direction, one at the center and the other three spaced at radial distances of $^1/_4$ the radius, $^1/_2$ the radius and $^3/_4$ the radius from the center. The holes should be about

120° apart. The exact location of the holes is actually unimportant.

These holes may vary from 1/16 to 1/8 in. in diameter. The operations of sawing out the specimen and drilling the holes should be done with a wet saw and with wet drills to avoid introduction of strain by these operations. Observation of the results is made easier if the saw cuts are filed off with a wet file or ground off with wet sandpaper.

Cracks below a rough surface (such as a saw cut) may be made visible by placing a few drops of oil such as machine oil on the surface and then placing over it a small piece of flat glass.

For production purposes and for pieces under 1 in. in diameter, one hole at the center and one about halfway out are sufficient. Small cracks around the ends of the drilled holes which show no tendency to spread into the main body of the material are due to drilling and may be disregarded.

Surface crazing along the saw cuts at or near the surface which do not show a tendency to spread deeply into the material may likewise be disregarded. If the sample indicates deep body cracks, even though small, a second test should be made using more care during the preparation of the sample. If this cracks, the annealing is not satisfactory. Examples of the type of results obtained from this test are clearly shown in the shadow graph (Fig. 1).

Procedure and equipment

Plax annealing is done in a water bath which is circulated by a propeller and which is temperature controlled by an automatic cycle controller. The tank is made of stainless steel and contains two sets of internal coils of copper pipe—one for steam which is the heating means and one for cold water which is necessary to force the cooling of the tank in the short cycles. Both the steam and cooling water temperatures are automatically controlled.

The controller is held to its cycle by a master cam which has been laid out to give the desired cycle. Each cycle is represented by a cam so it is only necessary to select the cam wanted, place it in position and set the controller in action. When the end of the cycle (150° F.) is reached, the rods are removed. A new load may be placed in the tank at once and allowed to heat up with the bath or the bath may be started up and the rods placed in at some higher temperature. The new charge of rods and the holding rack will drop the temperature of the bath somewhat and the cycle controller must not be started until the charge and bath are in equilibrium at 184° F.

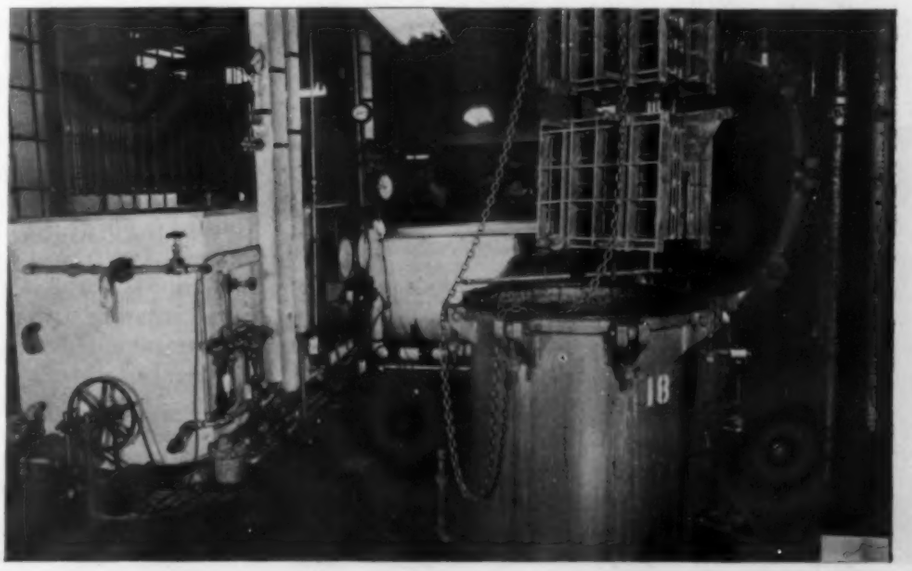
Preventing warp and spicules

Because of orientation strains, there is a tendency for the rods (especially those of 3/4 in. and under) to warp. As a means of preventing this, the rods may be packed in a metal slat rack which allows them very limited motion and keeps them straight during the annealing process. This rack is of rustproof metals. It is loaded outside the tank and handled in and out of the tank by a small hoist (Fig. 2).

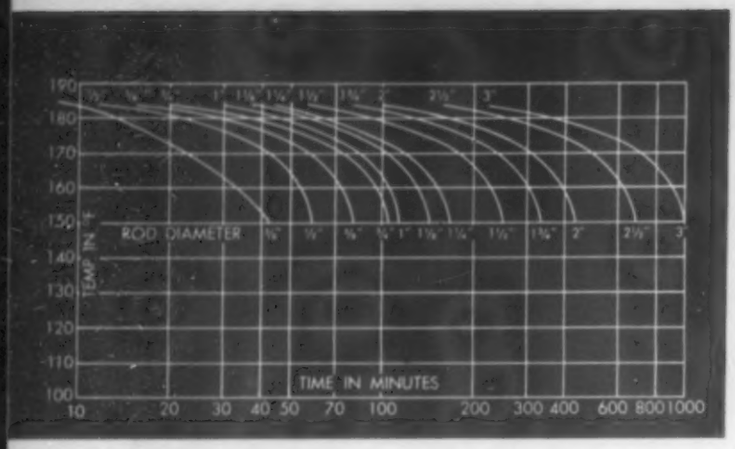
It has been noted that small spicules sometimes form in a ring around the outer 1/8 inch of the rods when they are annealed in a water bath. Spicules can be prevented by using a bath of ethylene glycol or a bath of ethylene glycol and water containing at least 40 percent glycol by weight.

Annealing cycles for round rods

The standard Plax annealing cycles are given in graph form (Fig. 3.). Ordinates are bath temperature in ° F., abscissas are elapsed time in minutes from the initial equilibrium temperature of the bath at 184° F. These cycles were worked out by our Physical Laboratory and have been tested and found satisfactory over a number of years. They are designed to give the shortest possible time for the required degree of annealing with a com-



2—To prevent plastic rods from warping during annealing process, they may be packed in a metal rack (right foreground) before loading in the water bath



3—Standard annealing cycles for round polystyrene rods

puted safety factor of 2. The cycle consists of four divisions:

a. The holding time at 184° F.
b. The initial slow cooling rate 184 to 170.
c. The next slightly faster cooling rate is from 170 to 160.
d. The final slightly faster cooling rate 160 to 150. At 150 the parts are removed and then allowed to air cool.

Theoretically, the time required during any of these cycles will vary as the square of the diameter if the stress at the center is kept constant. Hence any other cycle can be derived very simply if any one of them is known. It can be noted, however, that the cycles for 1 in. diameter and less are gradually lengthened over what would be required by the square law and that the shortest cycle is for $^3/_8$ in. diameter with a total time of 43 minutes. The reason for these departures is that the bath cannot be made to follow faster cycles with accuracy and that small temperature lags in the cycles for less than 1 in. diameter require a somewhat greater factor of a safety.

Annealing cycles for molded slabs

Plax approved and tested cycles for slabs are shown in graph form in Fig. 4 in which the ordinates are temperature in ° F. and the abscissas are total elapsed time in minutes from the time the bath reached equilibrium at 184° F.

These cycles were designed to give a residual stress and factor of safety of the same amount as that for round rods, namely, a stress less than 150 p.s.i. and a factor of safety of 2 on the time. They also represent the shortest annealing time that is consistent with the above conditions.

As with rods, the cycles are longer for thicknesses less than 1 in. than required by the square law. Like the rods, any cycle can be derived from any other cycle by varying the time in proportion to the square of the thickness. That is, the time for a slab 4 in. thick would be 4 times that of a 2-in. thick slab and 16 times that of a 1-in. thick slab. A slab requires twice the time of a round rod of the same thickness.

Parts machined from annealed stock

Machining strains in parts made from annealed stock are usually confined to a comparatively thin layer of material immediately adjacent to the machined surface. The annealing consists of removing the strains in this surface layer only and large body strains are not involved. A simple heating for short duration only is all that is required.

The system that the Plax Corporation devised to do this work consists of a small tank stirred by a small propeller, the temperature being accurately held at 182 to 184 ° F. by a thermostatically controlled electric heater.

Baskets are made of $^1/_4$ in. mesh wire screen into which the machined parts are loosely piled. The basket may be filled to a depth of 4 or 5 in. and may be any convenient size. It should have a cover so that the parts cannot be floated out of the basket. The whole is lowered into the bath so that it is covered by at least 1 in. of liquid and allowed to remain for 20 minutes. It is then lifted into the upper part of the tank so that its bottom is about 1 in. above the liquid and allowed to drain for 20 minutes. It is then removed and allowed to cool in the air until all parts have cooled to a temperature of 150° F. or below.

The tank level should be maintained and, because of the rapid evaporation of water at 184° F., ethylene glycol is usually more convenient. If used, the parts must be carefully washed to remove all traces of glycol as this is not a very good electrical insulator and does not dry readily from the parts. Swishing the baskets in several changes of warm water (about 140° F.) will usually remove the glycol satisfactorily.

Other methods of annealing

The Bell Telephone Laboratories have in the past specified an annealing procedure for certain war items made from polystyrene. In their specification the procedure calls for an oven treatment at a single temperature (170° F.) followed by cooling in still air at room temperature. In this specification the maximum diameter of the part is $1^3/_4$ in., and the piece must be heated in an air oven at 170° F. ±2° F. for 16 hr. followed by cooling at room temperature in still air. By referring to Fig. 3 it would appear that a much shorter time is possible with the Plax cycle, although the requirement of 16 hr. mentioned above no doubt contains a liberal margin of safety.

In addition, the Bell Telephone Laboratories specify that in testing the rods for annealing, a circular specimen $^1/_4$ in. long shall be cut from the approximate geometric center of rod and drilled with four $^1/_{16}$ in. in diameter holes spaced at least $^1/_4$ in. apart, center to center. One hole shall include the center of the disk

and the other three shall be on a circle described about the center of the disk. The drilled specimen shall be immersed in kerosene for 1 min. at 25° C. ±5° C., and the rod shall be considered as having been properly annealed if no crazing takes place during the next 30 minutes. Care should be exercised in preparing the test specimen in order to avoid the introduction of machining strains which will cause crazing even though the rod is well annealed.

Our laboratory has tested the Bell Telephone Laboratories annealing method and has found that it works satisfactorily. The Bell method has the advantage that an air oven with a simple single-temperature thermostat can be used instead of a water tank with an expensive cycle controller. Moreover, there should be no trouble from spicules or rust. The temperature can be easily adjusted to some other temperature corresponding to a different plastic whether lower or above the boiling point of water. However, it has the obvious disadvantage of being 2.85 times as long.

J. H. Du Bois has given a method for removing strains in molded polystyrene in his book entitled *Plastics:*[2] "Freshly molded polystyrene parts may be tested to determine whether or not they will craze by a procedure which consists of drilling a small hole and then applying a drop of kerosene. Any tendency to craze will show up quickly in this test. Products having heavy sections that show a tendency to craze may be improved by an annealing operation in which the part is baked 1 hr. at 160° F., 1 hr. at 170° F., and 6 hr. at 180° F. Thin pieces should be annealed at the highest temperature at which dimensional accuracy may be maintained."

The Plax Corporation has also tested the Du Bois[2] method and finds that parts up to $1^3/_4$ in. in diameter that are so treated will pass the kerosene test but that some unmolding occurs.

The patent literature discloses several other methods most of which are *tricky* and would be very difficult to reduce to a satisfactory commercial basis. Most of these are based upon a sudden change in the cooling cycle, intended to reverse the stresses due to cooling at some critical point in the cycle. The theory is involved and difficult to describe, but the method can be simply outlined as follows using glass as an example.

Suppose that a 1-in. diameter glass rod is heated to 1000° F. —its annealing point. All strains will be relieved by viscous flow in a few minutes. If this rod is air blasted to give sudden cooling of the outer surfaces, the rod can be brought down to room temperature in a matter of 20 min. or less. The rod will then have very severe compression on the outside and tension on the inside and will be *thermally toughened.* The lower strain point of such a glass is somewhere around 750° F. This is the lowest temperature at which any noticeable change in strain can be found no matter how much the stress may be.

Now suppose the air blast in our example is stopped at the instant the center of the rod reaches 750° F. The outer surface at this time will be nearly room temperature and under a high tension, whereas the center will be in compression. We now change the cold air blast to a hot air blast at a few degrees above the annealing point and start a hot wave traveling through the glass. It will require several minutes for this wave to reach the center. During this time the severe tensions in the outer layers will be reversed and become compression stresses and can relieve themselves to some extent, since the temperature is just slightly above that of the annealing point.

At the approximate time this latter heat wave reaches the center or just slightly before, the outer hot air blast is stopped and the rod permitted to cool naturally at a slow rate. A very short time later the temperature of the outside and the inside will both be at or near the lower strain point and no further changes in the strain distribution can take place. If this cycle is done just right, fairly good annealing of a 1-in diameter rod can be done in about 40 min., not counting the cooling period which takes place in air. If it is not done correctly, the strain distribution may be very bad. Such a cycle is too difficult to control in practice.

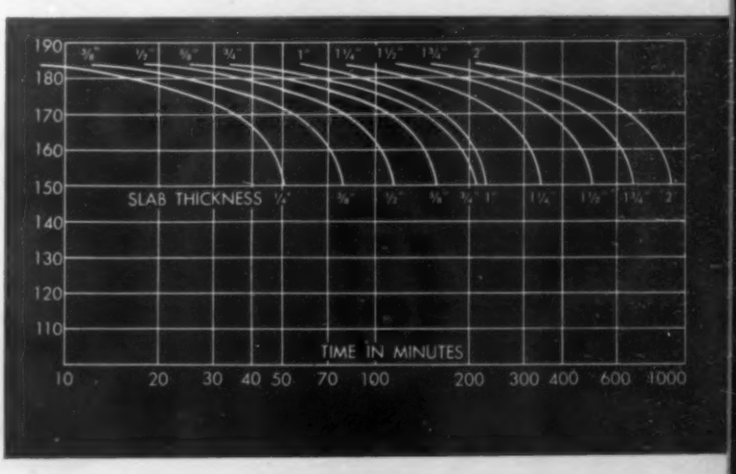
The usual procedure used by hand workers when annealing hand-blown chemical ware which consists of revolving the finished piece in a smoky flame is quite similar to the above in its effect.

Conclusions

The primary source of deep body cracks which have been a large factor in erratic behavior of polystyrene parts in service are thermally induced cooling strains which can be satisfactorily removed by an annealing process.

There are many other factors which set up similar strains in the material and cannot be overlooked. Its high coefficient of expansion (10 to 15 times that of steel), its low long-time strength, its susceptibility to various chemical and vapor solvents greatly increase the necessity for annealing but at the same time introduce problems which should be carefully considered prior to actual application.

4—Approved and tested annealing cycles for molded slabs



[2] American Technical Society, page 242 (1945).

Product of TELEX, Inc., Minneapolis, Minn.

TELEX tells an impressive PLASKON story

The TELEX under-pillow speaker is a new and extremely rugged electro-magnetic sound generating unit. It is designed for normal sound reproduction when placed under a pillow, or as a personal radio soft speaker not requiring headphones. Thousands already are in use in hospitals, hotels, homes, Pullman cars, bus lines, air lines and other places where soft, high-fidelity radio reproduction is desired.

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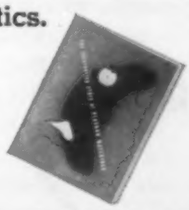
Plaskon materials have distinctive features that give them wide-spread application in the electrical, cosmetic, drug, garment and many other industrial fields. We shall be glad to help you adapt the many advantages of these versatile materials to your manufacturing and merchandising needs. Write for free illustrated book on Plaskon plastics.



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PLASKON

TRADE MARK REGISTERED

MOLDED COLOR

PLASKON DIVISION
LIBBEY • OWENS • FORD GLASS CO.
2121 Sylvan Avenue • Toledo 6, Ohio
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Equipment and technique of extrusion

Details of the processing of extruded sheets, tubing and wire coating, and the materials which are employed

by DR. RUSSELL B. AKIN*

EXTRUSION is generally understood to comprise the compacting of a plastifiable material and the forcing of it out through an orifice in more or less continuous fashion. The plastics industry, back about 1880, extruded cellulose nitrate from a *hydraulic stuffer*, a cylinder from which a piston forced a softened mass of cellulose nitrate through straining screens to homogenize, filter or form into strands. It was necessary to mix the nitrate with solvent in order to make the mass soft at temperatures low enough to preclude decomposition of the plastic.

This type of extrusion press was well suited to the material being handled because the extrusion chamber could be cleaned rather completely. However, it was of practical value only to material manufacturers because it required the formation of a billet for charging and the extruded material had afterwards to be seasoned or stored for a long time to remove the solvent.

Screw conveyors to extruders

Screw conveyors, much like a home meat grinder, had been used industrially in Italy early in the 19th century to form a rod or tube of macaroni. About 1880 the screw extruder was introduced in this country for the extrusion of rubber tubing. In this unit a screw carried rubber through a heated cylinder and forced it from an orifice in the shape of a rod, tube or tape. The screw rotated in a sleeve of hardened steel with a clearance of 0.003 to 0.005 in. on the radius.

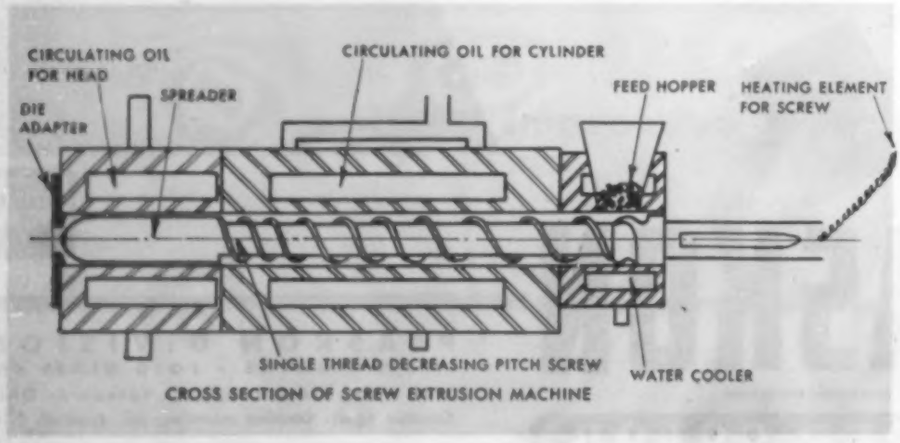
Because of the instability of cellulose nitrate, many early attempts to adapt the heated screw extruder to this plastic ended in failure. About 1900, however, commercial extrusion of this plastic became practicable with development of what were then called *screw stuffers*. In order to move the plastic at safe temperatures, it was mixed with solvent which had to be *seasoned* or evaporated out afterwards. This again had the effect of limiting the application of screw stuffers chiefly to plants of material manufacturers. Similar solvent extrusion was done with casein button stock in the early 1900's and with cellulose acetate in 1930. Now the solvent process is used only for extruded shapes of cellulose nitrate and polyvinyl alcohol, and to some extent in the extrusion of thin sheeting. Extruded goods so made come out of seasoning with a dull surface and are apt to warp.

By 1938, after years of experimentation, the continuous-screw rubber extruder was commercially adapted to *dry extrusion* of plastics, in which no solvent is employed. As with injection molding, the process became practical only upon development of cellulose acetate plastics. In the long run it may well be found that the most important influences of this material have been the improvement and advancement of machine design made possible by the stability and ease of working of cellulose esters.

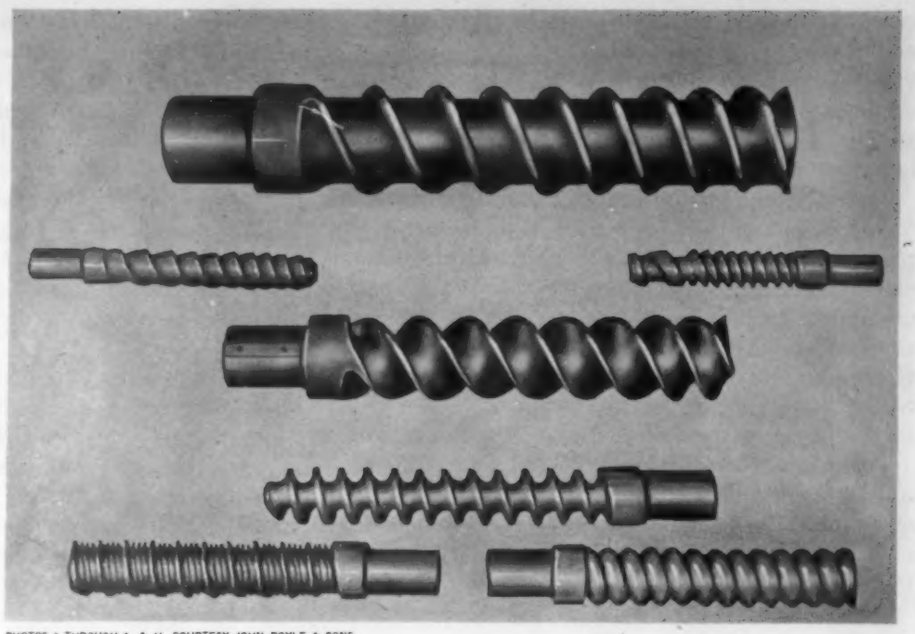
The present-day extrusion process

Fundamentally, the extrusion operation as the plastics industry knows it today comprises a screw device for advancing material through zones of controlled temperature. Rotating action of the screw in its closely fitting sleeve causes mixing, smearing and frictional

* Technical service engineer, E. I. du Pont de Nemours & Co., Inc.



1—*Material fed to hopper of this typical screw extruder is carried forward by the screw. It is then spread thin by spreader*



PHOTOS 1 THROUGH 4, & 11, COURTESY JOHN ROYLE & SONS

2—A variety of screws are employed in plastics or rubber extruders. These screws should be of hard alloys to minimize scoring

heating, and forces the plastic through an orifice or die to give it shape. This much of equipment is known as the extruder proper (Fig. 1). Essential accessories are a conveyor or other means for removing the product at uniform rate from the die, and equipment for cooling and for reeling or otherwise packing the product.

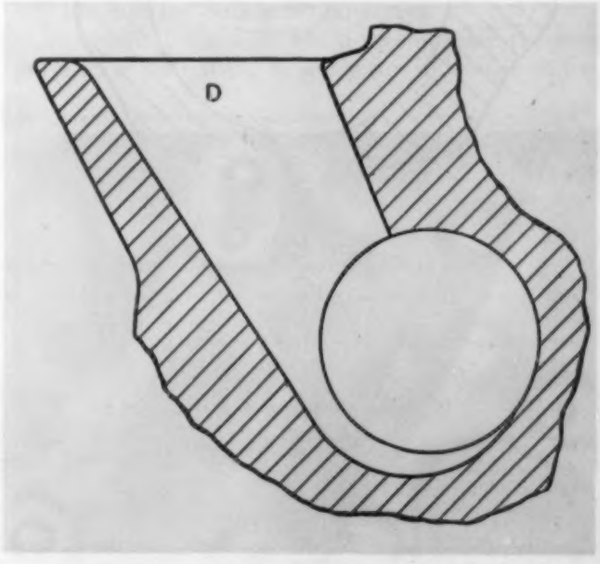
Let us consider in detail the following items as they relate to the extrusion process: 1) motive power, 2) source of heat, 3) design of screw, 4) design of screen, 5) design of die holder, 6) design of die, 7) take-off, 8) cooling, 9) accessories and 10) material requirements.

1. Motive power—Early extrusion machines were of small capacity, and intended for rubber which is more fluid than most plastics and was used to make products in which extreme dimensional accuracy was not expected. In comparison, extruders for plastics require heavier power sources for the screw, a 10 hp. motor being standard for a screw 2.5 in. in diameter and 20 in. long. To provide uniform delivery at the shaping die, the drive must be positive.

Control of the speed of the screw, variable with respect to rate of take-off, is essential. Screw speeds of 8 to 35 r.p.m. are used. For small installations, an AC motor with heavy duty starting shunts and an infinitely variable gear box is suitable. For larger setups, a motor generator set, using DC motors, is preferable. In such installations the conveyor also may be run from the same DC power supply, permitting synchronized change of speed of extrusion screw and take-off conveyor.

2. Heat source—The temperature to which stock is raised and the rate at which it is heated are almost equally important, though the latter factor is often ignored. Most plastics are extruded at temperatures at which they will begin to decompose if given sufficient time or access to air. It follows that the duration of heating at temperatures sufficient to homogenize should be kept at a minimum for a particular set of operating conditions. This means that the zone of maximum temperature should be as short as practicable.

Yet to supply all the needed heat at the exit or die end of the screw would necessitate barrel temperatures so high as to scorch the plastic. It has been general practice, therefore, to supply some heat, but not maximum temperature at the feed end of barrel. This is to ensure the partial plastification of the material before it reaches the ultimate smearing zone, reducing the load



3—Screw is represented as circle in cross section of a tangential feed, used to overcome bridging of particles While this drawing is of a feed used for rubber it illustrates the type of unit that is used for plastics.

on the screw and permitting release of entrapped air and vapor. To prevent *bridging* or agglomeration of the molding powder as it is fed into the screw, which would interfere with regular supply of stock, the feed section is frequently cooled by the means of circulating water.

Material temperatures range from 200 to 500° F. Steam is seldom used for heating because of the high pressures which would be necessary. Most extruders use a system which circulates thermostatically heated oil around the barrel or sleeve in which the screw and stock move. Dowtherm also is used. The new plastics and improved formulations of the old ones require higher extrusion temperatures, which impose severe limitations upon the choice of oil for heating system.

For material temperatures of 500° F., heating oil is usually heated above 520° F. Although exposure of oil to air at such temperatures can cause serious fires, much commercial extrusion is done with oil at these temperatures. Operating at 300° F., paraffinic oils will not be degraded in a month of continuous operation. Above 450° F., naphthenic base oils are preferred for their thermal stability although they are subject to rapid attack by oxygen. At such temperatures the expansion reservoir and entire system must be protected against access of air.

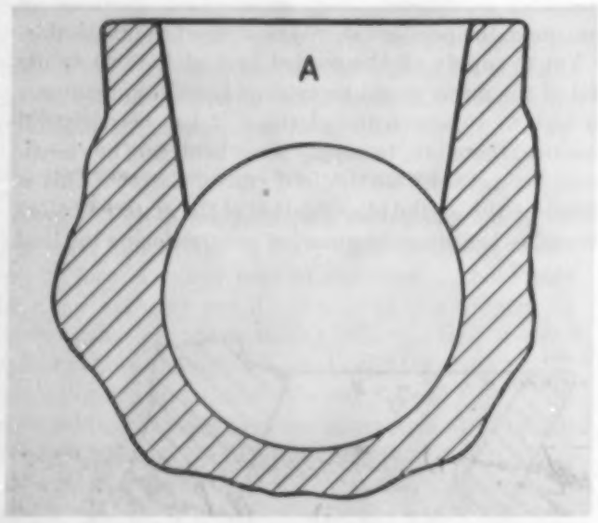
It is remarkable, even at rapid rates of extrusion, how much heat can be generated in a molding powder by the mixing action of the screw. In a typical methyl methacrylate composition, material temperatures of 440° F. were consistently measured while the circulating oil was at 400° F. Thus the circulating fluid may at times serve as a cooling agent, but seldom under uniform operating conditions.

In long runs, conditions will be attained under which any occasional cooling effect of circulating oil is not of important help. This is particularly true with the definite trend to higher barrel temperatures. Hence, the electric resistance heating is now coming into much wider use.

It is poor economy to attempt to control temperatures with hand-operated rheostats or auto-transformers. Instead, thermostatic controls are almost invariably used. For a small additional cost, the so-called proportionating control can be provided. This automatically decreases the power as the preset temperature is approached. Temperature changes in heating elements are then undetectable. Under a wide variety of conditions, this system has given results as good as those of the best circulating oil systems.

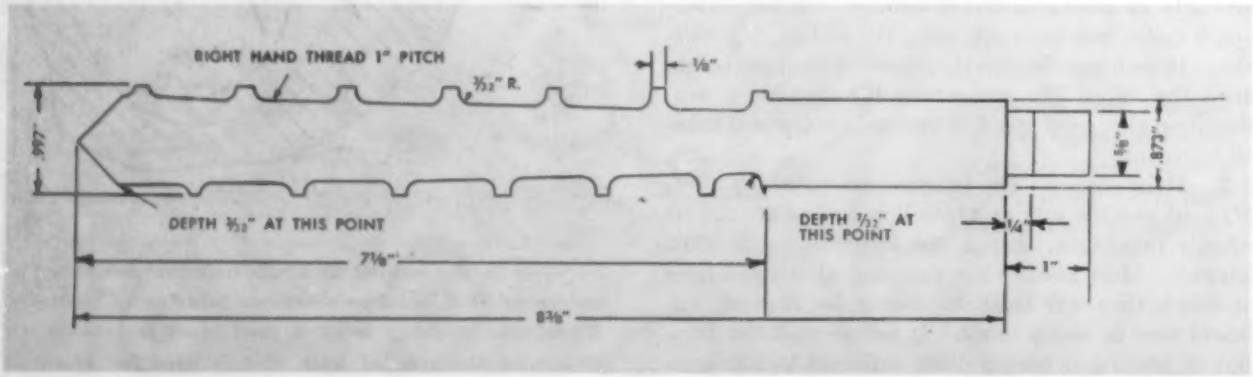
The power-consumption of resistance heaters applied directly to the barrel is somewhat less than that of circulating oil, because less heat is lost. For normal extrusion of plastics, it can be assumed that a kilowatt-hour supplied to heating oil will deliver a little more than 3000 B.t.u. to the barrel. It has been proposed to figure a pound of cellulose acetate extruded per 150 B.t.u. supplied, neglecting the frictional heat imparted by the screw. This would mean about 20 lb. of extruded cellulose acetate per kilowatt-hour of heating. A 2.5 in. screw would turn out this amount of material in 20 min. of operation of a motor of 10 hp., which in

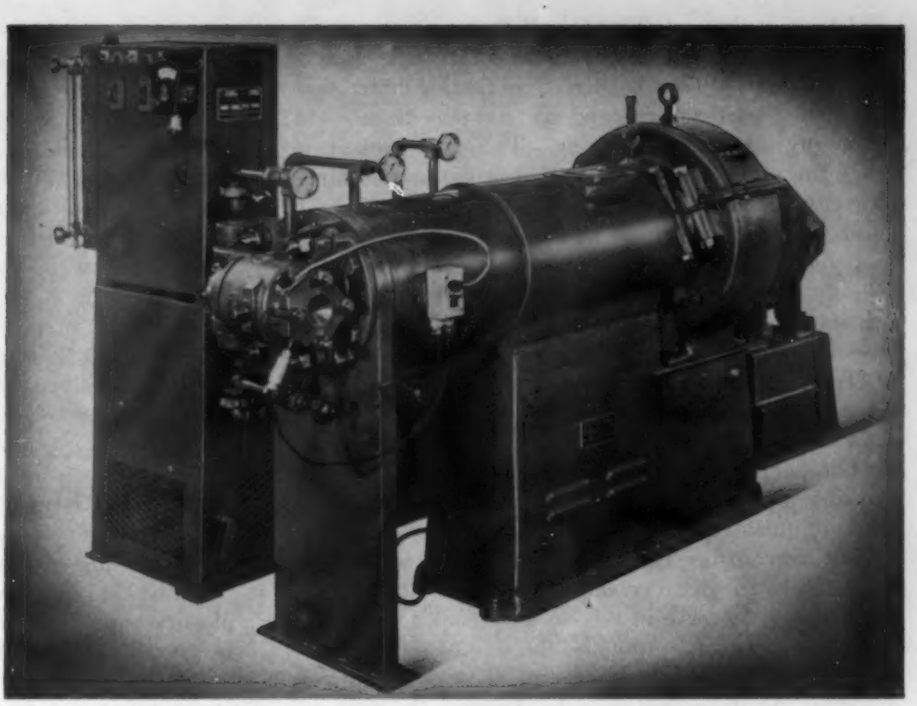
4—Another type feed is vertical chute shown here in cross section. The screw is again represented as a circle



5—A typical screw of constant pitch and varying depth for a one-inch extruder is most effective in feeding a range of particle sizes. The exit end can give any desired degree of smearing

PHOTOS 5 AND 10, COURTESY E. I. DU PONT DE NEMOURS & CO., INC.





PHOTO, COURTESY NATIONAL RUBBER MACHINERY CO.

6—This 3½ in. extruder for thermoplastics is equipped with wire insulating cross-head and an 18 kw. oil heating unit

this period of time would consume approximately 2 kilowatt-hours.

3. Design of screw—Of all the variables in design of extrusion equipment, probably none has brought forth so much debate as the design of the screw. The important thing to note is that people still buy screws of each of the types proposed in the past. (Fig. 2 shows these screw types.)

Because of continuous exposure to friction and chemical attack at high temperature, it is customary to build extrusion screws and barrels of hard alloys to minimize scoring and the resulting entrapping of material where local corrosion may be accelerated. Hard chrome plating may be used to provide resistance to abrasion and better chemical resistance than is offered by tool steels. Hard lining sleeves are preferred. For some extrusion, as with vinyl chloride or vinylidine chloride resin, Hastelloy or other corrosion-resisting alloy is recommended—not only to protect the machine, but also to prevent a decomposition of the plastic catalyzed by iron which may become violent.

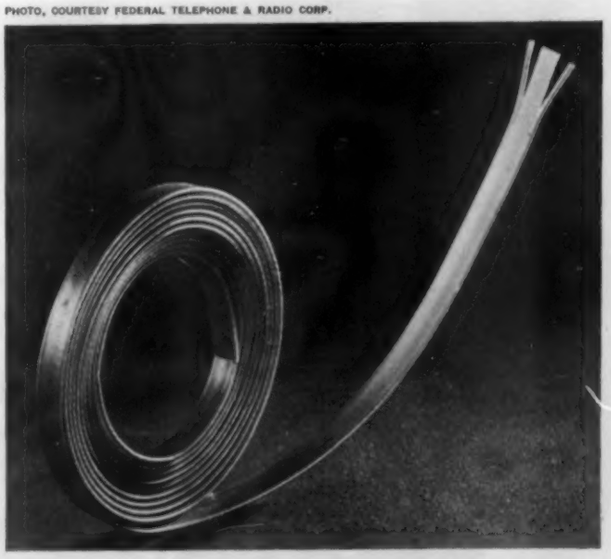
Feed to the screw may be interrupted by bridging or agglomeration of particles at the bottom of the feed chute. This is best overcome by a tangential feed (Fig. 3) rather than one that is vertical or perpendicular to the axis of the screw (Fig. 4). Similar results are accomplished less expensively by cutting a slot in the bottom of the sleeve a few inches away from the feed chute.

Because of the high bulk factor of granular molding compositions, it is necessary that the screw at the feed end take large bites of stock and pass them along to the plastifying zones. In the latter zones it is not desirable to pass the material so rapidly, since there must be time for the mixing, softening and de-aeration of the plastic. Thus, the rate of progression of material must be greater at the feed end and decrease as compacting takes place.

This change in rate of passage may be accomplished by decreasing pitch, or spacing between flights, of the screw toward the exit end. This is the most common practice. A more expensive construction adds a second set of flights at the exit or die end. This will reduce the pulsation or *spilling off* of material as the end of thread periodically reaches any given position, and will increase the homogenizing action.

An alternative design, which accomplishes the same purpose, is the cutting of screw thread deeper at feed

PHOTO, COURTESY FEDERAL TELEPHONE & RADIO CORP.



7—This extruded lead-in cable is typical of the extrusion operations that can be done in the electrical field

end than at die end (Fig. 5). If flights are the same distance apart, they may be cut with a single milling cutter. Such a screw is effective in feeding material of a range of particle sizes, and exit end may be made to give any degree of smearing. The disadvantage is that the screw has its smallest root diameter, and is therefore weakest, at the drive end. Good results have been achieved with this design of decreasing depth.

Some extrusion screws end in a smooth section fitting closely into the constriction in the barrel. Although an integral part of the screw, this mandrel section is usually called the *spreader* or *torpedo*.

To adapt rod or shape extruders to wire coating, etc. (Fig. 7), the side delivery head (Fig. 6) was devised and it is the most widely used setup. Here the screw can be cut deeper or it may be bored along its axis for internal cooling or heating. Feeding of wire and cleaning of die are much easier than in a straight flow extruder.

4. Screening—To the uninitiated, screens interposed between delivery end of the screw and the die might seem to serve merely to keep back foreign material in the stock. Actually, the screens serve also to exert a back pressure on the stock which improves m'xing, facilitates softening by keeping the material far longer and under greater friction in the heating zone, and also reduces pulsation of feed.

Stainless steel wire is almost always used for the screens. In a recess in the die-holder a breaker plate or perforated disk of steel is inserted, of thickness from $^1/_8$ to $^5/_8$ in. depending on the expected thrust. Against the breaker plate are laid from 3 to 12 screens which are held erect by clamping the whole assembly against the end of the extrusion barrel. The last screen almost touches the end of the extrusion screw. Meshes used range from 10 to 150, and some extruders prefer weaves which give oblong rather than square openings. Preferably, the fine meshes are preceded by coarse screens to prevent the masking of fine holes by particles of incompletely plastified stock.

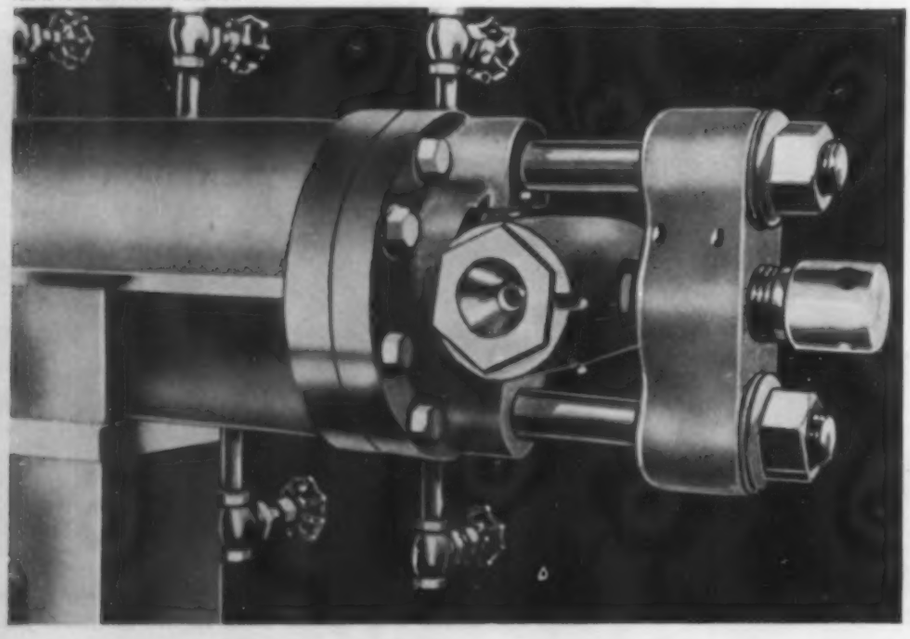
5. Die-holder—The injection molding branch of plastics industry has pretty well standardized die shapes and nozzle adapters, and hence any particular injection mold can generally be used in any of the standard brands of injection machines. This standardization has not been achieved in extrusion of plastics.

Three manufacturers make almost all of the extruders used in this country, and there is no general interchangeability of dies from one machine to another. One brand uses a sort of C-clamp arrangement, the die being held against the barrel of the extruder by means of a cross-piece bolted to two studs projecting from the barrel (Fig. 8). Other machines are equipped with a flanged die or die-holder and have the die bolted directly to the barrel through this flange.

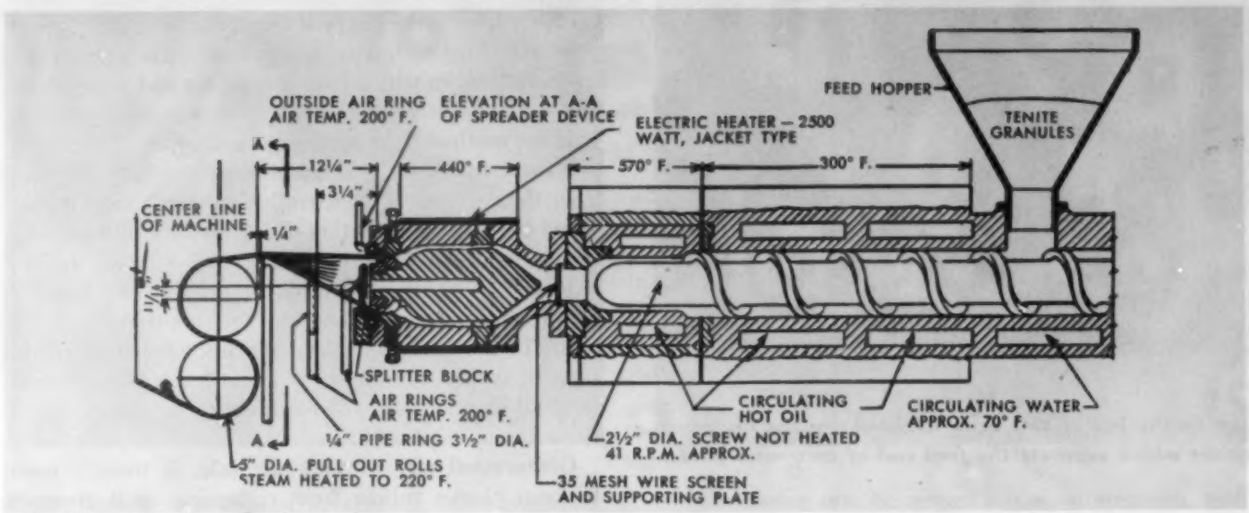
The use of a cross-head or T-head has been described for converting a plastics extruder into an insulating machine. A considerable amount of extrusion of plastics shapes is also done with such a cross-head because of the flexibility of the setup and ease of cleaning and of changing die. The cross-head is simply an adaptor fastened to the head of the extruder barrel to change the direction of flow of plastic. Usually, the change is 90°, but 45° deflection has been used in this country and Germany, as well as two 45° turns to give the effect of a single 90° change.

6. Design of die—As indicated above, there is no unanimity of design in die holders. It follows that there is a wide variety of designs for extrusion dies. Fortunately, the pressures on the die are small and hardened steel need be used only for very long runs. This means that a production die can be made and whittled to final contour by hand filing. The real problem is adjusting orifice to the size required for extruded tubing, kitchen-counter-edging, zipper stock, etc.

PHOTO, COURTESY NATIONAL ERIE CORP.



8—Considerable amount of extrusion of plastic shapes is done with this cross-head mechanism because of its flexibility



PHOTO, COURTESY TENNESSEE EASTMAN CORP.

9—Cellulose esters or vinyl chloride sheeting is sometimes made by extruding a tube, splitting it as it leaves die. Process obviates problem of difference in flow between edge and center

Because of the softness of the stock at the extruder orifice, the rate of take-off is of great importance in determining the relation between cross sections of the orifice and dimensions of the desired product. The orifice may be the size of the product, may be slightly smaller, or may have a cross-section considerably greater than that of the product in order to allow for the effect of stretching as stock is carried from the nozzle.

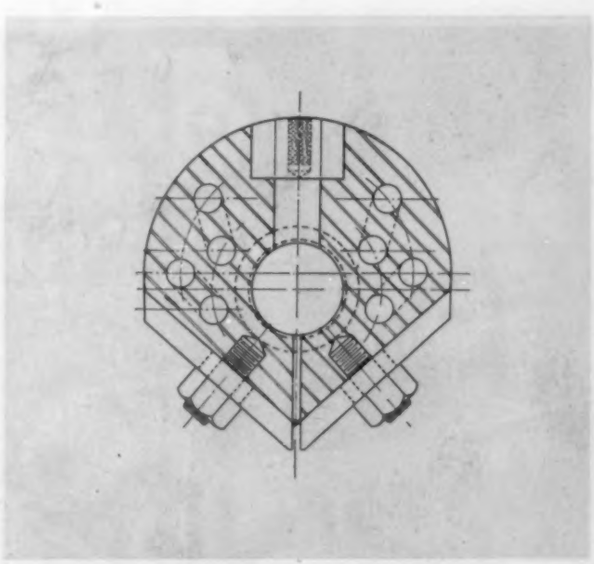
The center of volume of the die should be placed as near as possible to the axis of the screw to reduce pulsation corresponding to the ends of flights and to hold to a minimum the strain in the stock as it emerges from the extruder. The die must be streamlined and highly polished. A little time and money spent on this finishing will quickly be repaid in ease and success of operation. To assist the flow at the orifice, resistance cartridge heaters or oil ports are almost always used, with control independent of that of the barrel. Length of land—that is, the axial dimension—is from $^1/_8$ to 8 inches.

When a bar is extruded from a rectangular orifice, the sides of the bar are bulged, giving a cross-section that somewhat resembles that of a sofa pillow. This is due to the greater drag at the corners of the die. The remedy is to enlarge the corners in relation to the center sections, i. e., to make an orifice which is concave on the sides. Alternatively, although less advisable, the lands may be shortened at the corners to reduce the drag effect.

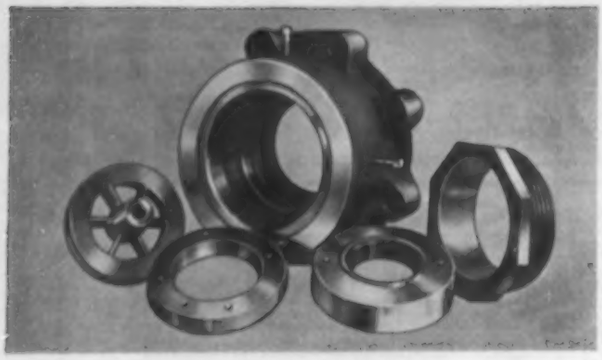
The tendency of the extruded plastic to drag or tear at the corners is particularly pronounced in thin tape or sheet. For this and other reasons, thin sheeting of cellulose esters or polyvinyl chloride is sometimes made by extruding a tube and splitting it just after it leaves the die (Fig. 9). This process obviates problems raised by difference in flow between ends and center of a straight-slit sheeting die. The tubing technique for preparation of flat sheeting requires rather expensive tooling of die and take-off equipment.

Sheeting of a highly fluid material such as nylon or polythene can be made quite readily in a flat die of uniform cross-section. Such a die with a small turbulence chamber is shown in Fig. 10. Although not always necessary, the addition of heater bands to the ends of this die will result in improvement of flow for wide sheeting.

The terminology of extruder parts used in tubing or wire coating may be confusing to the layman. The term *die* is restricted to that part of the mold which forms the outside of tube. The *core* or *mandrel* forms the inside of tube. The *bridge* (Fig. 11) is a spider



10—In extrusion of sheet, plastic enters die vertically from extruder at top. Sheet emerges from slit at bottom



11—To the left of this extruder head are the bridge—a spider which supports the feed end of core—and guider

which supports feed end of the core or mandrel just beyond the screen assembly, and may be made in one piece with the core. In wire coating, the center of the bridge is the point where the wire enters the die, and the bridge is then called a *guider*. Wall thickness is governed by advancing the tapered lands of the core into the orifice and by adjusting the plane of the bridge with respect to orifice. More modern designs support the guider at its downstream end so that the bridge is not required.

In pressure coating of wire, the guider tip is positioned behind the land of the die or the surface which forms the outer diameter. By this method a plastic mass is formed about the wire and dragged through the die, which swedges the outer diameter.

In the tubing technique for coating, a tube is extruded concentric with the wire and the wire is pulled through at a greater rate so as to draw down the tube snugly about the wire. In the tubing technique, the guider tip is flush with the die face or may extend slightly beyond it. This technique works best with highly fluid compositions, in which case it is faster and gives automatic and positive concentricity of wire and coating. It is the method used for thin jacketing, as of nylon on polythene for Army field telephone wire.

In the early days of extruding rubber tubing it was found that the introduction of soapstone would prevent the tacky tube from collapsing and sticking before vulcanizing. This is done by the head having a series of ports around the periphery of the core that forms the inside of the tube. These ports are connected with a tank of soapstone or talc, which is fed by compressed air, and blow a smoke or fog of talc continuously into the tube.

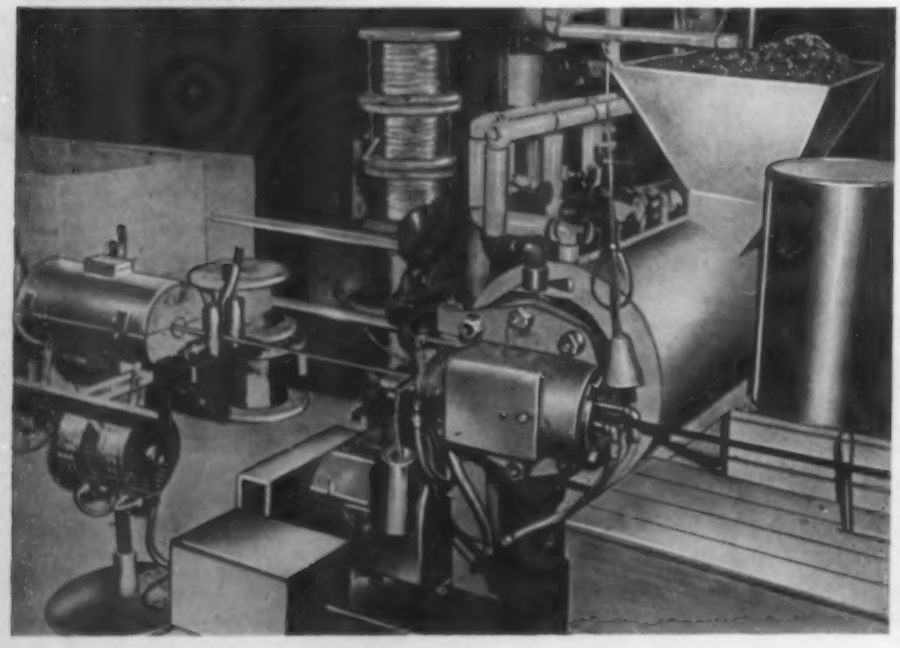
Compressed air, without the talc, is usually used to keep plastic tubing from collapsing as it emerges from the die. Pressure will rarely exceed one pound per square inch and it must be throttled through a manometer which has a free blow-off to the atmosphere.

To ensure the snug fit of extruded wire coatings, a procedure exactly opposite to that used for tubing may be employed. A vacuum may be applied to the extruder orifice to cause atmospheric pressure to make the insulation conform to the wire. This procedure is followed when insulation is applied by *tubing* rather than *full pressure* technique.

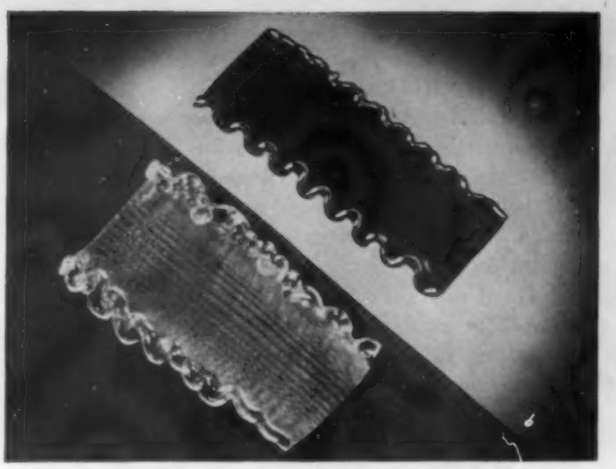
It is frequently desirable to preheat the wire which is to be coated (Fig. 12).

7. Take-off—The rate at which plastics are withdrawn from an extruder orifice is a critical factor in the uniformity of the physical qualities and dimensions of the finished product. The take-off may be by conveyor belt, squeeze rolls or capstan. The take-off mechanism must not only control this rate but also support the soft plastic while it can still be readily deformed. If

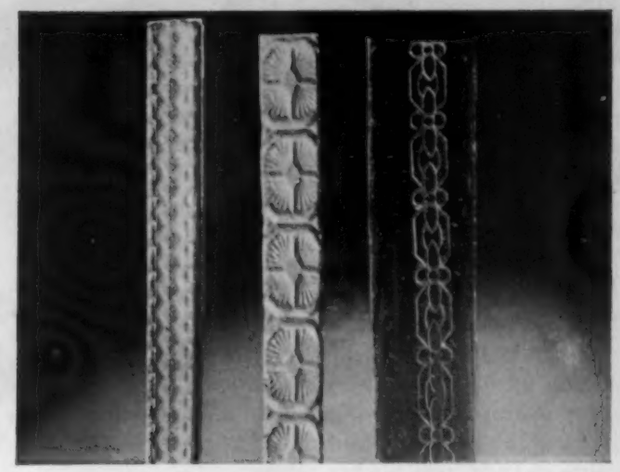
PHOTO, COURTESY FEDERAL TELEPHONE AND TELEGRAPH CO.



12—A wire preheater and cross-head fastened to extruder head are shown in this close-up of one wire insulating machine



13—*By taking advantage of drag at die edges, scalloped edge can be put on material with normally straight edge*



14—*Embossing can be carried out simultaneously with extrusion so figure or grain is impressed on hot material*

squeeze rolls are used, the support comes from the liquid bath placed just beyond the rolls. Standardized, but adaptable, conveyors are sold by several manufacturers of extruders.

8. Cooling—Cooling can be by exposure to the atmosphere, although this means it is too slow for the usual rates of extrusion. An alternative is the use of blasts of cooling air. Where rapid cooling is desired, the product may be immersed in a liquid which acts not only to cool but also to support. Obviously, water is the cheapest liquid and it also has the highest heat capacity of any practical liquid. For special cases (as with water-soluble polyvinyl alcohol) kerosene, acetone or other liquid may be used.

The rate of cooling and the distance from the extruder die at which the cooling should begin, are always a matter of cut-and-try. Too rapid cooling may cause the formation of a cold hard shell while the center of the mass is still deformable, and thus results in the formation of voids in the center as this subsequently contracts, and also in warpage if the cross-section is a non-symmetrical one. To avoid this case hardening and its bad results, the first cooling water is relatively hot. Thus, when heavy coatings of polythene are applied to wire for coaxial cable, the insulated wire is passed successively through water at 190 to 160°F., 160 to 140°F., 150 to 100°F. and 100 to 70°F., each zone being 15 ft. long. Additional cooling water is provided around the capstan.

9. Accessory equipment—This should include ovens for drying or preheating powder and compressed air for blast-cleaning, cooling and keeping the tube stock inflated. Usually the percentage of moisture in the powder fed into the extruder must be limited, in most cases to 0.25 percent.

10. Materials—In the earlier days, plastics extruders had to be content with purchase of compositions intended for injection molding. Both the material manufacturers and their customers have learned that this is not the best procedure. Most suppliers now have compositions developed solely for extrusion.

Factors influencing the behavior of the material in the extrusion equipment are not only the chemical composition, but also the particle size, moisture content and temperature at which the machine is charged. The feeding of a granular powder from a warming and drying oven is replacing the feeding of extruders with strip plastic sheeted on adjacent rolls or purchased in sheet form from suppliers. Strip stock is still commonly fed to wire insulating equipment.

At slow rates of extrusion with cellulose esters, and to a lesser extent with vinyls, continued heating in an extruder may vaporize enough plasticizer to cause bridging at the feed end by agglomerating particles of molding powder. Also, unduly volatile plasticizers may escape from extruded products that have a large ratio of area to volume, and thus cause warpage during cooling. Common practice is to use larger proportions of less volatile plasticizers in an extrusion composition of, say, cellulose acetate, than in an injection composition of the same material. Generally, a quick-setting composition is preferred, in order to minimize the chance of distortion after the hot plastic leaves the die.

Since the extrusion of plastics is a branch of the industry with a large potential consumption, it is natural that material suppliers, thinking of their newer products, should develop compositions aimed at the extrusion field. These will, for the most part, be materials of superior electrical properties, or of greater heat- or solvent-resistance than the established cellulose esters, cellulose ethers or highly plasticized vinyl derivatives.

The field for extruded products

One material which is being increasingly employed for extrusion is polythene, because of its very low power factor and its flexibility, which is not attained in other plastics without the introduction of objectionably

large quantities of plasticizer. The electrical qualities of polythene have led to its use in radio and radar, and its exceedingly low water-absorption and freedom from plasticizer and from loss of plasticizer have led to its introduction into the field of submarine telephones and cables. This material is being extruded in the usual equipment of the wire industry. Polythene is also being extruded into tubing for sausage-wrapping and for protection of metal equipment, and into sheeting for many wrapping applications. The frozen food industry is a large potential customer.

Other materials new to the extrusion industry are certain members of the nylon family. Several of the older nylons introduced some years ago for injection molding are not at present applicable to extrusion because of their high fluidity. New and chemically different nylons were introduced for use as abrasion-resistant and solvent-resistant jackets over polythene, neoprene or rubber. In the case of Army field telephone wire, an ordinary plastics extruder without mechanical changes was used to extrude a jacket 0.005 in. thick over primary insulation. By similar application of tubing technique in small extruders, jackets less than 0.001 in. thick have been applied at high speed to wires as fine as American wire gage No. 38.

It is certain that other plastics will be developed for extrusion work, the trend being toward higher material temperatures and more crystalline products. This will necessitate more careful handling than is necessary with the older materials which offered good control of viscosity through adjustment of barrel temperatures.

The material manufacturers are not the only ones who have been busy on development work. Operators of plastics extrusion machines work for the most part with intangible factors which necessitate cut-and-try methods. For this reason, their stock in trade is a know-how which is jealously guarded.

While full details of the techniques cannot be given, it is known that several organizations are developing techniques for multi-colored extruded products. These will involve the use of several screws forcing material through one or two orifices or the extrusion of a soft composition over a harder core of a contrasting color. Products of such operations will be used for decorative trim and for marking of electrical circuits which may be sheathed in such tubing or tape. The line between adjacent colored sections may be sharp or diffuse, depending upon the technique of preparation.

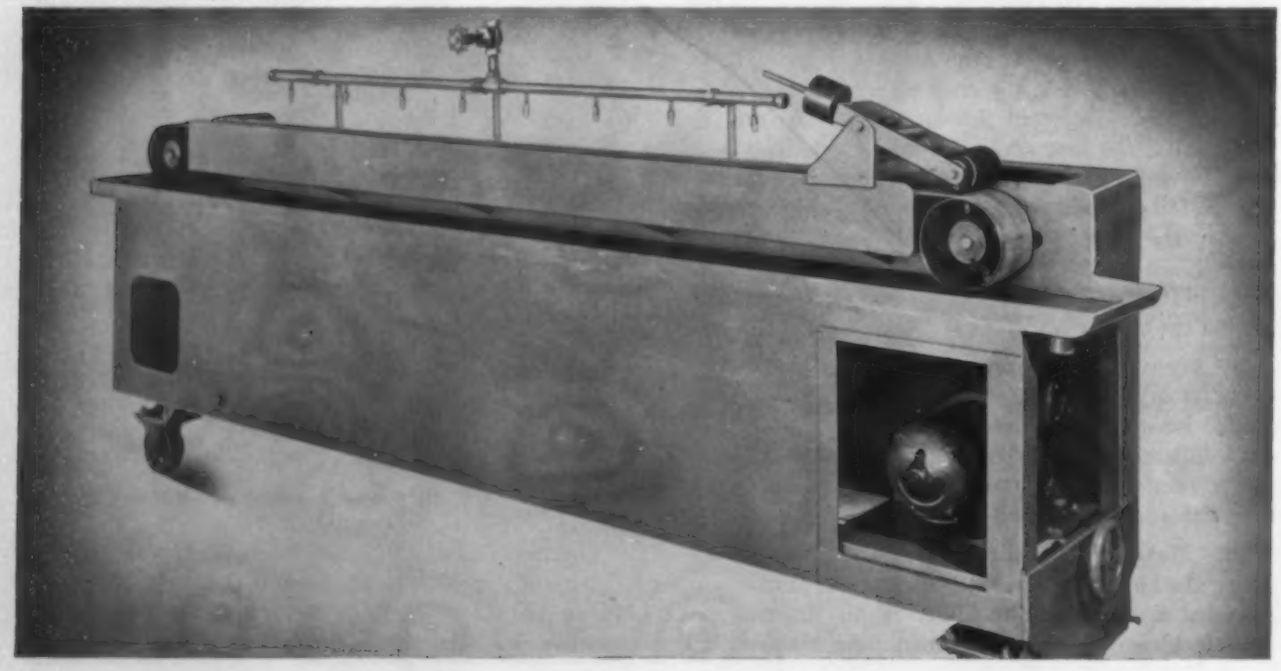
The adaptation of extruding machines for what amounts to injection molding process was described in MODERN PLASTICS in the September 1945 issue.

For many years, it has been assumed that an extruded product must necessarily have the same cross-section at all points along its lengthwise dimension. The preparation of extruded tape of uniform edges has been the aim of many extruders of plastics. However, some recent work has taken advantage of the drag at the edges of the die. Thus, a scalloped edge can be put on material which would normally have a straight edge, by judicious application of heat to the edges upon emergence from the die (Fig. 13).

Recently, embossing has been carried out simultaneously with the extrusion so that the grain or figure was impressed upon the material while hot. This obviates the need for reheating and, at the same time, ensures more permanent embossing than that done on cold stock. Such a product is particularly effective in decorative applications (Fig. 14).

15—A water cooled conveyor for extruded materials, approximately 11 ft. long and having a 6 in. wide belt

PHOTO, COURTESY NATIONAL RUBBER MACHINERY CO.



Airplane control wheels dipped in Tenite gel lacquer by Scott Aviation Corp.

Tenite Gel Lacquer Coats Airplane Control Wheels

Plain wooden tool handle (left) gets thick plastic coating with Tenite gel lacquer (right).

A few dips in Tenite gel lacquer produced the hard, lustrous, touch-pleasant surface of these airplane control wheels. The lacquer, made by dissolving Tenite pellets of the desired color and opacity in suitable solvents, provides the aluminum castings of the wheels with an economical finish much thicker than can be obtained by the same number of dips in ordinary lacquers.

Tenite gel-lacquer coatings are continuous, with complete absence of the parting line which appears on molded products. They may be applied to wood as well as to metal, and to certain plastics, including articles molded from scrap of mixed colors. Among the products which can be coated are handles of kitchen utensils and tools, towel bars, and long bars which are beyond the capacity of a machine for covering by injection molding.

For information concerning the preparation of gel lacquer from Tenite pellets, write to TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Company), KINGSPORT, TENNESSEE.

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Yet today's glue is more than a common, everyday thing. New synthetic resin adhesives join wood with a bond that doesn't let go. Veneers stick. Beautiful grained woods stay glued permanently. These adhesives provide a low-cost glue for plywood. Place wood in new fields of usefulness.

Cyanamid's resins and resin adhesives are known as URAC, MELMAC, MELURAC, and PHENAC. In certain formulations some types form weather-resistant, boil-resistant, or craze-resistant glue lines. Others can be used for low or high pressure bonding. In some instances, these adhesives form strong glue lines in thicknesses up to .020 of an inch. Complete data and technical help are available upon request. American Cyanamid Company, Plastics Division, 32 Rockefeller Plaza, New York 20, N. Y.

CUPS AND DISHES molded from Cyanamid's MELMAC plastic are designed for infants as well as grown-ups. Lightweight and easily handled, MELMAC tableware is durable, attractive, odorless and tasteless, with a hard, lustrous surface. It is now available at retail department stores. Dishes shown here are manufactured by the Watertown Manufacturing Company.

◀ **SMOOTH, WHITE-MOTTLED FACINGS** around the lower inside walls of taxicabs are some of the toughest parts of the car. These laminates are on door panels, side walls, and the underside of folding seats where heels and baggage give them a continual beating. The attractive melamine resin surface is resistant to water and staining, provides a high gloss, is abrasion-resistant and can be cleaned easily. These laminates were produced by Formica Insulation Company.

Cyanamid Plastics

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The Use of Uniform Claremont Cotton Fillers in Your Plastic Formulations Insures Easier Processing, Greater Strength, Better Products!

The specifications of the above pictured parts called for an improved impact molding material. The need was for strength sufficient to prevent breakage in handling . . . and tough enough to anchor-in the large inserts. The answer was found in Monsanto's Resinox 5675 compounded with Claremont Cotton Flock Filler.

While the strength factor of the molding compound was of the utmost importance, the choice of *Claremont Flock Filler* not only made it possible for the plastic formulation to meet the highest structural requirements . . . but also preserved its good molding qualities.

All Claremont Cotton Fillers (Flock, Thread, Macerated Fabric, Cord) are carefully graded, clean, uniform in size . . . and processed to your special needs. Whatever strength factors your molding compound requires, you can be certain that one of Claremont's four types will meet—and surpass the specifications. Samples available. Inquiries invited.

Item Shown—Case and Cover for NEMA Push Button Station.

Cutler-Hammer, Inc. of Milwaukee, Wisconsin molded these parts of Monsanto Chemical Co.'s Resinox 5675.

CLAREMONT WASTE MANUFACTURING CO.
CLAREMONT, NEW HAMPSHIRE
THE COUNTRY'S LARGEST MANUFACTURER OF FLOCK

Manufacture of laminates in Germany*

Based on the production manual of Dynamit A.-G., Troisdorf. This translation was prepared for publication by Dr. G. M. Kline and Mrs. I. G. Callomon, National Bureau of Standards

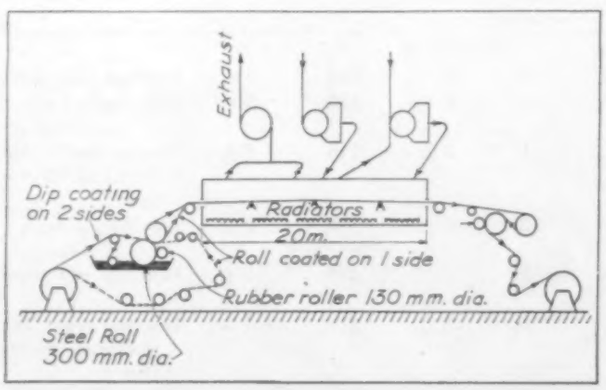
THIS report covers the preparation by Dynamit A.-G., a subsidiary of I. G. Farbenindustrie A.-G., of paper-base and fabric-base laminates and of paper and fabric sheet materials used for molding purposes. The papers and fabrics used during the war period in Germany were all derived from wood pulp.

The I. G. paper-base laminates are marketed under the trade name *Trolitax*. The composition, processing conditions and applications of the various types are tabulated in Table II. Similar data for the fabric-base laminates, which are known as *Dytron*, are presented in Tables I and III. The phenolic resin-impregnated fabrics which are used to mold laminated parts are described in Table IV; they are classified as *Trolitan* products along with the other I. G. phenolic molding compounds. The manufacturing procedures for the phenolic resins referred to in Tables I, II and IV have been reported previously in another issues of this magazine.[1]

The I. G. molding compounds made with pulp and paper were described in a previous report.[2] Trolitan Type 51 contains ground soda pulp as the filler and Trolitan Type 54 consists of resin-impregnated paper used to mold paper-base laminated parts. Another type of paper-base molding material is made by mixing the resin and pulp in a beater and forming the admixture

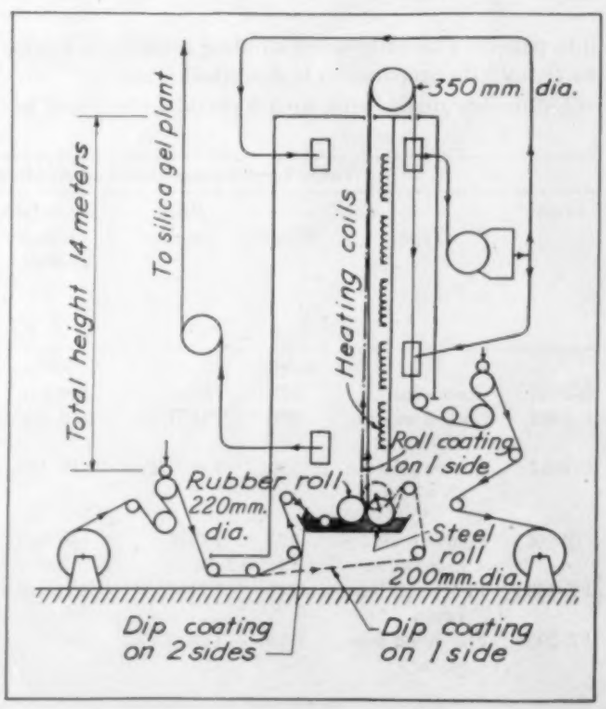
* The information contained in this report was obtained in a three months' investigation of the important plastics plants in Germany made by the senior translator under the auspices of the Office of the Chief of Ordnance, War Department. The Department of Commerce is merely distributing this technical information which has come into its hands from captured German territory. This information should be made available to all United States citizens interested in it but use of it by anyone must be and is at one's own risk in so far as the U. S. or foreign patent violations are concerned. This report is PB 33273.

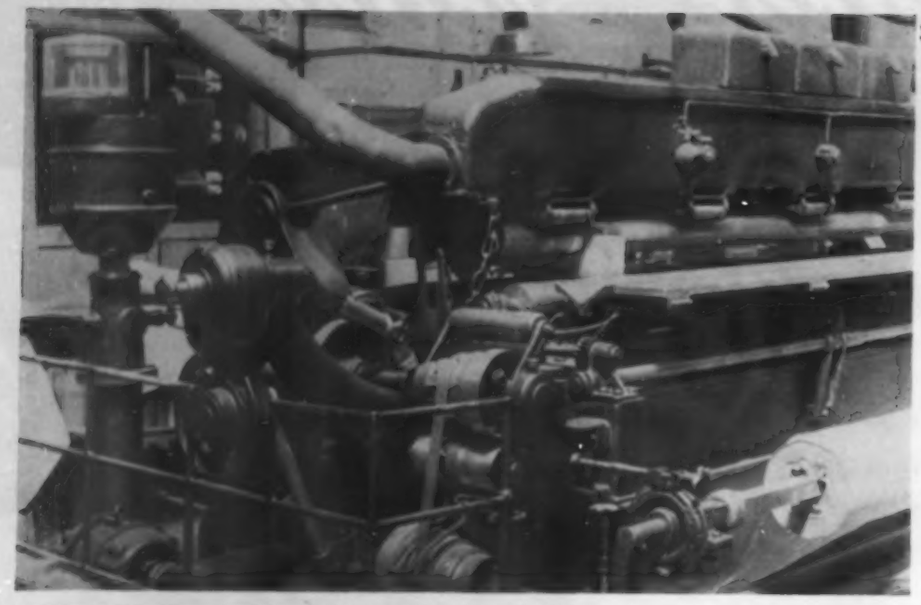
1—*A diagram of the horizontal type coating machine*



[1] "German Manufacture of Phenolic Resins for Molding and Laminating," MODERN PLASTICS 23, 155–158, 206 (Aug. 1946).
[2] "Manufacture of Phenolic Molding Compounds in Germany," MODERN PLASTICS 24, 160–162, 196 (Sept. 1946).

2—*The other type coating machine is built vertically*


350 mm dia.
To silica gel plant
Total height 14 meters
Heating coils
Roll coating on 1 side
Rubber roll 220mm. dia.
Steel roll 200mm. dia.
Dip coating on 2 sides
Dip coating on 1 side



3

4

3—A machine for rolling laminated rods and tubes at Dielektra A.-G., Porz. Three rollers constantly maintained 60 contact points on round objects being rolled. 4—End view of the rollers, temporarily blocked apart with yokes

into paper. This pulp-sheet molding material is known as *Dynal;* its preparation is described later.

Laminates made with urea-formaldehyde resin are designated by the I. G. trade name *Pollopas.* The preparation of a laminate of this type is covered in Table II; the manufacture of the urea-formaldehyde resin is described in this report. Urea laminates with a core of cresol-resin impregnated sheets are also made in thicknesses up to 3 mm. Above 3 mm. thickness such core sheets are not used because the curing temperature for urea-formaldehyde resin laminates is 120° C. and the cresol resin would not cure in the thick panels in the permissible heating time.

Coating and laminating equipment

The coating machines at Troisdorf are of two types—vertical (Fig. 2) and horizontal (Fig. 1). The vertical type is used for heavy fabric and the horizontal for paper grades. Both types are steam heated and can be arranged to coat one or both sides of the paper or fabric at one pass. The exhaust from the drying oven is to be connected to an alcohol recovery plant operating

Table I.—Composition and Applications of Dytron Fabric-Base Laminates

Grade	*Fabric*		*Resin used*	*Amount of coating applied*	*Amount of resin applied*	*No. of sides coated by dip-coating*	*Speed of passage through machine*	*Drying temperature*	*Loss on drying of finished sheet*	*Applications*
	Type	*Weight*								
		g./m.²		*%*	*%*		*meters/min.*	*° C.*	*%*	
G-2081	Coarse cotton	575	T3SM	100–110	53	2	2	110	3–6	Bearings and gears
F-2082	Cotton mixture 33/67	225	T3E/LTx	110–120	53	1	2.5	110	3–6	Bearings and gears
F-2082	Cotton mixture 33/67	150	T3E/LTx	110–120	53	1	2.5	110	1.5–3	Die-cut parts for electrical insulation
GZ-2085	Coarse wood-base rayon	575	T3SM	100–110	53	2	2	110	3–6	Bearings
FZ-2086	Fine wood-base rayon	225	T3SM	100–110	53	1	2	110	3–6	Bearings and gears
FZ-2086	Fine wood-base rayon	150	T3E/LTx	100–110	53	1	2	110	1.5–3	Die-cut parts for electrical insulation

Table II.—Composition, Processing Conditions, and Applica

Trade designation and thickness	*Paper*[a]			*Cover sheets*									
					Resin coatings								
					First passage			*Second passage*			*Amount of coating applied*	*Amount of resin applied*	*Drying temperature*
	Type	*Weight*	*Absorption height (Klemm test)*	*No. of sheets on each face*	*Resin used*	*No. of sides coated*[b]	*Speed through machine*	*Resin used*	*No. of sides coated*	*Speed through machine*			
		g./m.²	*mm.*				*meters/min.*			*meters/min.*	*%*	*%*	*° C.*
Trolitax Class I, 2061 (construction-type; natural brown)													
0.5– 1.0 mm.				1									
1.0– 3.0 mm.				2									
3.0– 5.0 mm.				3									
5.0–15.0 mm.				3									
15.0–30.0 mm.	2150	71	25–35	4	T3E/LTx	2	13.5	T3E/LTx	2	13.5	110–120	53	110–12
30.0–50.0 mm.				5									
50.0–65.0 mm.				5									
65.0–80.0 mm.				5									
Trolitax Class II, 2062 (punching-type; natural brown)													
0.2– 1.0 mm.				1									
1.0– 1.5 mm.				2									
1.5– 3.0 mm.	2150	71	35	2	T3E/LTx	2	13.5	T3E/LTx	2	13.5	110	53	110–1
3.0–10.0 mm.				3									
10.0–30.0 mm.				4									
Trolitax Class III, 2063 (telephone-type; natural brown)													
0.3– 0.5 mm.				1									
0.5– 1.5 mm.				1									
1.5– 3.0 mm.	2150[e]	71[e]	35[e]	2	T3E/LTx	2	10.5	T3E/LTx	2	10.5	110–120	53	1
3.0–10.0 mm.				3	(Pale)			(Pale)					
10.0–30.0 mm.				4									
Trolitax Class IV, 2064 (telephone-type; natural pale)													
0.3– 0.5 mm.				1									
0.5– 3.0 mm.				2									
3.0– 5.0 mm.	Cotton rag paper[f]	50 or 80	15	3	T3E/LTx (Pale)	2	5.5	T3E/LTx (Pale)	2	5.5	110–120	53	100–1
5.0–10.0 mm.				4									
Trolitax Kondensator[c] (condenser-type; natural brown)	606M	40	...	...	...	...	...	...	...	...	...	...	...
Trolitax Punching Stock[d] (natural)	2150	71	...	1	T3SM	2	10.5	T3E/LTx	2	13.5	110	53	1
Trolitax Konstruktion 125 (construction-type; natural brown)													
1– 3 mm.				1									
3–10 mm.	2150	71	35	2	T1/LTx	2	10.5	T1/LTx	2	10.5	120	53	100–1
10–30 mm.				3									
Trolitax Drawing Instruments 155[g]	606M[h] and cotton rag paper[i]	40–45 80	... 25	2	80 parts T3E/LTx; 20 parts T5	2(D)	8.5	...	...	...	80	45	70–8
Trolitax Wood-Grain													
0.3– 1.0 mm.				1[j]									
1.0– 3.0 mm.	2150	71	...	2[j]	T3E/LTx	2	13.5	T3E/LTx	2	13.5	110–120	53	110–1
3.0–10.0 mm.				3[j]									
Pollopas Konstruktion 144 (construction-type; natural brown)													
3– 5 mm.				2									
5–10 mm.	2150	71	35	3	H144	1	4.0	...	...	...	110	53	80–9
10–20 mm.				4									
20–30 mm.				5									

[a] Papers 606M and 2150 are Kaemmerer soda-pulp insulating grades. [b] Application of resin solution by direct passage through bath instead of picking up coating from rolls is indicated by (D). [c] Made in 0.1 an 50 or 80 g./meter² and having an absorption of 25 mm. is used. [f] The paper is first dried by one passage through the machine to a loss on drying of 1.0 to 1.5 percent. [g] Made usually in thicknesses of 0.5 to 3.0 mm. cover sheet is printed on one side by the "Masa" graining process. It is first coated on the printed side and then on the unprinted side with resin T3E/LTx (Pale) at a running speed of 6.5 m./min. Total amount o

and Applications of I. G. Paper-Base Laminates

			Filler sheets							Laminating conditions			Applications
nount of esin plied	Drying tempera-ture	Loss on drying of finished sheet	Resin used	No. of sides coated[b]	Speed of passage through machine	Amount of coating applied	Amount of resin applied	Drying tempera-ture	Loss on drying of finished sheet	Tempera-ture	Pressure	Time	
%	°C.	%			meters/min.	%	%	°C.	%	°C.	kg./cm.²	min.	
			T3E/LTx	1	13.5	55	38	110–120	4–6	165–170		90	Die-cut electrical insulation
			or							165–170		90	Electrical insulation
			T43SM	1	13.5	55	38	110–120	5–7	165–170		90	
										165		120	Switchboards and panels
			T3E/LTx	1	13.5	65	40	110–120	4–6		120		
53	110–120	3–5	or							165		135	
			T43SM	1	13.5	65	40	110–120	5–7	160		165	Mechanical equipment parts
										160		180	
			T3E/LTx	2(D)	4.5	70	43	110–120	4–6	160		210	
			T3SM										
						45	33			160		60	Die-cut electrical insulation; can be punched cold
						45	33			160		60	
53	110–120	3–5	or	1	12.5	45	33	110–120	5–7	160	120	70	Same but can be punched warm
			T43SM			55	38			165		90	Instrument panels; insulation
						55	38			165		120	Mechanical equipment parts
										160		60	
										160		60	Die-cut parts for low voltages
53	110	3–5	T3E/LTx (Pale)	1	10.5	70	43	110	4–6	160	120	70	
										160		90	Electrical insulation, terminal boards, switch plates
										155		120	
						110				150	120	45	Die-cut parts for telephone and radio equipment
53	100–110	2–3	T3E/LTx (Pale)	2	...	120	...	...	...	150	120	60	
						120				160	90	90	Electrical insulation, terminal boards, switch plates
						120				160	90	120	
...	...	...	80 parts T3E/LTx; 20 parts T5	2(D)	8.5	65	40	70	3–5	165	120	60	Electrical insulation
53	110	4–6	T43SM	1	13.5	35	27	110	5–7	160	120	60	Die-cut parts; can be punched cold
												60	Table tops, boat building
						60	40					90	Switchboards, battery boxes
53	100–110	3–5	T1/LTx	1	10.5	70	43	100–110	4–6	160	120	120	Flanges, mechanical parts
						80	45						
45	70–80	3–5	T3E/LTx	1	10.5	70	43	110	4–5	160	120	60	Drawing instruments
												60	Clock cases, radio housings
53	110–120	3–5	T3E/LTx	1	13.5	55	38	110–120	4–6	165	120	90	Furniture industry
												120–150	Switchboards, desk, table tops
												90	Table tops (odorless)
53	80–90	5–7	H144	1	5.0	70	43	80–90	5–7	120	120	120	Instrument panels
												120	Parts for machine equipment
												150	

[a] Made in 0.1 and 0.15 mm. thicknesses, using 2 and 3 sheets, respectively. [d] Made in 0.5 to 3.0 mm. thicknesses. [e] This paper used for natural brown product; for lighter stock a cotton rag paper weighing 0.5 to 3.0 mm. [b] Cover sheets. [c] Filler sheets. [f] Bottom surface only. The top surface of each panel is covered with one wood-grain cover sheet underlaid with one regular cover sheet. The wood-grain total amount of resin coating applied is 110 to 120 percent, corresponding to a resin content of 53 percent. Drying temperature is 110 to 120° C.; loss on drying of finished sheet is 3 to 5 percent.

Table III.—Laminating Conditions for Dytron Fabric-Base Laminates

Thickness	Time at 160° C.	Time schedule for pressure during hardening period[a]			Cooling time	—Loading in platens—		Loss on drying of finished panel (1 hr. at 110° C.)
		At 20 kg./cm.²	At 50 kg./cm.²	At 70 kg./cm.²		Panels per opening	No. of openings	
mm.	hr.	hr.	hr.	hr.	hr.			%
0.5–3	1	...	...	1	1	5	5	3–4
3–5	1½	...	...	1½	1	5	5	3–4
5–30	2	½	½	1	1	3–1	5	3–4
30–40	2½	½	1	1	1	1	5	3–4
40–60	3	½	1	1½	1½	1	5	3–4
60–80	3½	½	1	2	1½	1	4	3–4
80–100	4	1	1	2	1½	1	3	3–4
100–120	4½	1	1	2½	1½	1	2	4–6
120–150	5	1	2	2	2	1	1	4–6
150–180	7	2	2	3	3	1	1	4–6
180–200	8	2	2	4	4	1	1	4–6

[a] Panels up to 40 mm. thickness were made in size 1500 by 650 mm.; final pressure on these was 85 to 95 kg./cm.², depending on the press capacity. Panels from 40 to 200 mm. were made in size 1580 by 720 or 760 mm.; final pressure on these was about 70 kg./cm.²

on silica gel, but this plant was not in operation then.

The dried impregnated sheet is cut to size on a Koebig cutter and is built up to give panels of the desired thickness. The build-up of the laminated material for pressing is as follows: a rough metal sheet, a layer of unimpregnated paper sheets about 0.5 cm. thick, a polished metal sheet, the layers of resin-coated material, a polished metal sheet, unimpregnated paper, a rough metal sheet. The object of the unimpregnated paper layers is to even out any irregularities. The polished sheets are normal steel and are lubricated by being wiped over with a solution of the potassium salt of a paraffin oxidation product made by I. G.

For highly polished surfaces, chromium-plated brass sheets 2.5 mm. thick are used. These chromium-plated-sheets are also used for urea laminated materials. Duralumin press plates, 2.5 to 3 mm. thick, have also been used successfully. Special surface finishes are produced by using suitably engraved press plates. Laminated boards have been made with aluminum top layers. The aluminum was not treated in any manner except sand blasting.

Colored laminated materials are made either by using a dyed top sheet or by using dyes in the resin. For black materials both colored papers and dyed resins are employed.

High frequency heating has been tried experimentally for laminated sheets. The sheets were heated by high frequency current to 110 to 120° C. while under slight pressure and were then put into the laminating presses.

Laminated rod and tubes are made by rolling impregnated paper on a former for tube and without a former for rod. The paper roll for rod is started by hand and is continued on a rolling machine of the same type as is used for tube. The tube or rod is driven by being placed on two rotating heated rolls and held in position by a third heated roll placed on top. This top roll is not positively driven. The temperature of the rolls is about 120° C. depending on the type of material being made. Tubes and rod are then heated in molds. The rod is made in an assortment of sizes from 30 to 150 mm.

The laminating presses (*Please turn to page 208*)

Table IV.—Description of Resin-Fabric Trolitan 77/1609 and 77/1309 for Molded Laminated Parts

Product no.	Fabric: Type	Fabric: Weight	Resin used	Amount of coating applied	Amount of resin applied	Impregnation process	Speed of passage through machine	Drying temperature
		g./m.²		%	%		meters/min.	° C.
114a	Cotton mixture 33/67	150	T4/LTx[a]	100–110	51	Dip-coated on one side	3.0	110
						Roll-coated on one side	3.0	110
131a (Aircraft parts)	Cotton mixture 33/67	150	T1/LTx	100–110	51	Dip-coated on one side	3.0	110
						Roll-coated on one side	3.0	110
171a	Fine wood-base rayon	150	T4/LTx[a]	90–100	48	Dip-coated on one side	3.0	110
						Roll-coated on one side	3.0	110
173a	Fine wood-base rayon	150	T1/LTx	90–100	48	Dip-coated on one side	3.0	110
						Roll-coated on one side	3.0	110
208b (Bearings and bushings)	Coarse wood-base rayon	575	T4/LTx[a]	60	35	Dip-coated on two sides	1.5	110
						Roll-coated on one side	3.0	100

[a] Resin T4 of 90–100 cp. viscosity; no chalk added.

Wood treatment with urea resin-forming systems

(dimensional stability)

by MERRILL A. MILLETT and ALFRED J. STAMM*

Thin cross sections of Sitka spruce, sugar maple and white oak were impregnated with urea-formaldehyde resin-forming systems, either in the form of commercial dimethylolurea or as a mixture of urea and formalin. When properly cured, antishrink efficiencies of 40 to 50 percent can be obtained with either of these resin mixes. This is about two-thirds of that obtainable with the water-soluble phenolic-treating resins at the same resin content.

A 2 to 1 ratio of formaldehyde to urea was shown to give the best results. The urea-formalin mix was found to be superior to dimethylolurea in stabilizing wood dimensions.

Buffering the resin-forming system at a pH of 8.0 not only gives higher antishrink efficiencies but also prolongs the life of the resin in the treating solution.

Cure conditions were found to be about the same as for the phenolic-treating resins, namely, 310 to 320° F. for 20 min., or 220° F. for at least 48 hours. Lower temperatures than the latter required excessively long cures to give optimum antishrink efficiencies.

Urea-formalin mixes seem to have somewhat better stability than dimethylolurea solutions when used under the same conditions.

THE treatment of wood with urea resin-forming systems has been highly publicized during the last few years.[1–3] Much of the early work on the subject was done at the Forest Products Laboratory.[4,5] This work showed that the formation of urea-formaldehyde resins in wood increased its hardness and water resistance. During the war, however, work on the treatment of wood with urea resin-forming solutions was very limited because the early results were not so promising as those obtained with phenolic resin-forming solutions.[6–10] In the realization that peacetime requirements may not be so exacting as those of wartime, the Forest Products Laboratory recently resumed research on this subject to obtain more data on properties of the treated products under various conditions.

The data presented in this article deal with the effects of variations in treatment on the dimensional stability of treated wood. Treatment variables considered were: formaldehyde-urea ratio, pH, resin content and curing conditions. Small, thin cross sections of wood were used as samples to obtain the ultimate results possible for completely treated wood. It must, of course, be realized that such results are not directly applicable to larger-sized wood articles or lumber. Study on treatment of such items are contemplated.

The effects observed were evaluated by means of antishrink efficiency calculations. Antishrink efficiency is defined as the percentage reduction in cross sectional shrinkage (tangential plus radial) between the water-soaked and the oven-dry condition which is caused by the treatment.

$$\text{Antishrink efficiency} = 100\,\frac{\text{Shrinkage of untreated sections} - \text{Shrinkage of treated sections}}{\text{Shrinkage of untreated sections}}$$

At the completion of the tests on the urea resin-forming systems, matched sections were treated with a representative phenolic resin-forming system and tested to obtain directly comparable results.

Materials used

The measurements were made on thin cross sections of Sitka spruce, white oak and sugar maple prepared from air-dry stock. Specimens 3 by 3 in. in cross section were cut from 6-ft. long planks of each species. These were jointed to make one face as nearly parallel to the annual rings as possible. Full-length specimens, 2 by 2 in. in cross section, were then cut with the faces parallel and at right angles to the jointed face. These were cut into thin cross sections $^{3}/_{32}$ in. in the fiber direction. All edges were lightly sanded to remove any loose fibers, thus facilitating measuring and weighing. Such cross sections have been found most suitable for

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[1] J. F. T. Berliner, Southern Lumberman, 140–141 (Dec. 15, 1943).
[2] J. F. T. Berliner, Chemical Industries 54, 680–682 (1944).
[3] H. Manchester, American Forest 50, 334–335, 365 (July 1944); Reader's Digest 45, 43–44 (Aug. 1944).
[4] "Forest Products Laboratory urea-plasticized wood (Uralloy)," Forest Products Laboratory mimeograph 1277, 6 pp. (revised Aug. 1943).
[5] W. K. Loughborough, "Process for resinifying lignocellulosic materials," U. S. Pat. 2,313,953 (Mar. 1943).
[6] H. K. Burr and A. J. Stamm, "Comparison of commercial water-soluble phenol-formaldehyde resinoids for wood impregnation," Forest Products Laboratory mimeograph 1384, 20 pp. (1943).
[7] A. J. Stamm and R. M. Seborg, Ind. Eng. Chem. 31, 897–902 (1939).
[8] A. J. Stamm, R. M. Seborg, Trans. Amer. Inst. Chem. Eng. 37, 385 (1941).
[9] A. J. Stamm and R. M. Seborg, "Forest Products Laboratory resin-treated wood (Impreg)," Forest Products Lab. mimeograph 1380 (revised Dec. 1943).
[10] A. J. Stamm and R. M. Seborg, "Forest Products Laboratory resin-treated laminated compressed wood (Compreg)," Forest Products Laboratory mimeograph 1381, 13 pp. (revised July 1944).

Table I.—Effect of Formaldehyde to Urea Ratio Upon the Antishrink Efficiency of Sitka Spruce

Formaldehyde to urea ratio	*Unbuffered dimethylolurea*		*Buffered dimethylolurea (pH 8.0)*		*Buffered urea-formalin (pH 8.0)*	
	Resin content after leaching	*Antishrink efficiency*	*Resin content after leaching*	*Antishrink efficiency*	*Resin content after leaching*	*Antishrink efficiency*
	%	%	%	%	%	%
0.67	20.4	3.5	7.3	−2.0	6.9	1.6
1.0	31.9	19.8	13.0	4.1	15.2	10.3
1.2	37.3	31.9	17.9	22.6	18.9	22.8
2.0	30.8	41.1	20.3	41.1	24.3	44.8
3.0	24.2	30.7	11.6	25.3	15.4	31.7
4.0	17.4	27.1	9.1	28.2	11.2	28.8
6.0	11.7	20.7	5.8	16.9	7.1	26.7

all antishrink efficiency measurements[7, 9] as they are much better matched than when cut in any other way. They furnish both radial and tangential dimensions large enough for precise measurement, and they are very easily treated due to the fact that every fiber is cut across at least once. Variations due to non-uniformity of treatment are thus eliminated. Hence the data represent the optimum antishrink efficiency obtainable with uniform distribution of the treating agent throughout the structure.

Fresh commercial dimethylolurea was obtained from E. I. du Pont de Nemours & Co., Inc., under the trade name of Arboneeld. Crystal urea and formalin solution were also obtained from the same source.

The water-soluble phenolic-treating resin used for comparative tests was obtained from Interlake Chemical Corp., formerly the Central Process Co., and designated as No. 1652. It is representative of the water-soluble resins used for making Impreg and Compreg.[7]

A series of borax, boric acid, sodium carbonate buffers was prepared as directed by Clark[11] with pH values of 7.0, 8.0, 8.6, 9.2 and 10.0, containing about 1 percent of buffer solids.

Resin-forming variables

Formaldehyde to urea ratio—In order to study the effect of varying the formaldehyde to urea ratio on the antishrink efficiency, three series of solutions were prepared in which the ratio varied from 0.67 : 1 to 6 : 1, all solutions being held to a 20 percent resin-forming solids content by weight. The first series contained unbuffered dimethylolurea, the second dimethylolurea buffered at a pH of 8 and the third consisted of urea-formalin mixes also buffered at a pH of 8. In the last two series 50 cc. of buffer solution was substituted for the same amount of water. The treating was conducted as follows:

Three cross sections of oven-dry spruce, numbered consecutively, were placed in a crystallizing dish to which had been added 100 g. of the resin solution. After covering with a watch glass, the dishes were placed in a vacuum desiccator and evacuated for 15 min. with a water aspirator pump to remove entrapped air. Following this the sections were allowed to stand in the treating solution overnight to allow for thorough diffusion into the cell-wall structure.

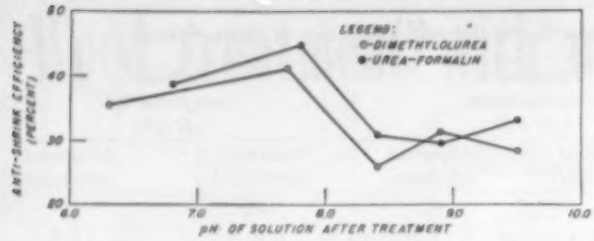
The treated sections were placed on paper towelling for about 10 min. to remove surplus solution. They were then weighed and the radial and tangential dimensions measured with a dial gage. Three adjacent control sections were treated in the same manner, using 100 g. of distilled water for the sections matching those treated with the unbuffered resin systems and 100 g. of solution made up of 50 g. of distilled water and 50 g. of buffer solution for those matching the sections treated with the buffered resin systems. This same treating procedure was followed throughout the study.

A preliminary group of test specimens was cured by air drying for 24 hr., followed by 24 hr. at 220° F. Swelling tests on these specimens showed very low antishrink efficiencies and indicated that a large proportion of the resin-forming solids were leached out during the soaking period. Consequently, a new series was prepared and curing accomplished by air drying for 24 hr., press curing for 20 min. at 310° F., and oven drying for 24 hr. at 220° F. This procedure, which is the same as that usually used for antishrink efficiency tests on phenolic resins, gave, as will be shown later, practically complete cure of the resin.

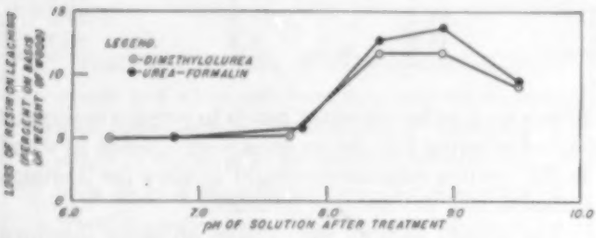
The cured sections, after weighing and measuring, were placed in a vacuum desiccator partly filled with water. A vacuum was pulled for 1 hr. with a water aspirator pump. The sections were then allowed to soak for a period of 1 wk. in running water to remove any unpolymerized resin-forming chemicals. The sections were again weighed and measured, then air dried for 24 hr. and oven dried for 24 hr. at 220° F. All the antishrink efficiency values were calculated on the basis of the dimensional changes between the leached swollen condition and the final oven-dry condition. The variation of antishrink efficiency with formaldehyde to urea ratio is shown in Table I.

Although in practice, wood is rarely subjected to such severe leaching as was used in these tests, the high degree of leaching makes it possible to differentiate between cured and uncured resin and gives the antishrink efficiency under the most severe exposure con-

[11] W. M. Clark, "The determination of hydrogen ions," 3rd ed., Williams and Wilkins Co., Baltimore, 717 pp. (1928).
[12] L. Smidth, "Process for treating fibrous materials and products so produced," U. S. Patent 2,376,200 (May 15, 1945).



1—*Effect of pH on antishrink efficiency of Sitka spruce*


LEGEND
○-DIMETHYLOLUREA
●-UREA-FORMALIN
LOSS OF RESIN ON LEACHING (PERCENT ON BASIS OF WEIGHT OF WOOD)
pH OF SOLUTION AFTER TREATMENT

2—*Loss of resin on leaching as influenced by pH for Sitka spruce. The plotted values are those in equilibrium*

ditions. Experience has shown that the antishrink efficiency obtained with soluble chemicals in successive 30 to 90 percent relative humidity cycles decreases with the number of cycles. Antishrink efficiencies determined by the method given here have not shown a decrease with age of the specimen or number of cycles.

A resin mix having a ratio of 2 mols of formaldehyde to 1 mol of urea gave the highest antishrink efficiency. At this ratio there is no appreciable difference in the three resin systems tested. Buffering, however, greatly increases the working life of the treating system and prevents deposition of ineffective resin within the wood. Unbuffered dimethylolurea gives a considerable amount of sediment during the treating period, and the amount increases daily without further use of the treating solution. The presence of this non-antishrink effective precipitate is indicated in Column 2 of Table I where high apparent resin contents were obtained without correspondingly high antishrink efficiency values.

The lower resin-content values for the buffered systems with ratios of formaldehyde to urea both less than 2 to 1 and more than 2 to 1 suggest that below this ratio free urea is leached out and above this ratio free formaldehyde is leached out of the sections during the soaking period. In the unbuffered system it appears that resin is formed throughout the ratio range of 1 : 1 to 2 : 1.

After treatment of the wood, the pH of the unbuffered treating systems ranged from 5.5 for the 0.67 to 1 formaldehyde to urea ratio to 4.0 for the 6 to 1 ratio, as a result of extraction of acid from the wood. Under these acidic conditions the resin tends to precipitate very rapidly. Although the precipitation is not sufficiently rapid to reduce the antishrink efficiency on the first treatment of such small sections, reuse of the solution after precipitation has occurred will give considerably reduced antishrink efficiency values. Buffered dimethylolurea at a 2 to 1 ratio showed only a slight precipitate 1 wk. after treating, while the corresponding buffered urea-formalin treating solution was still perfectly clear 3 wk. after treatment.

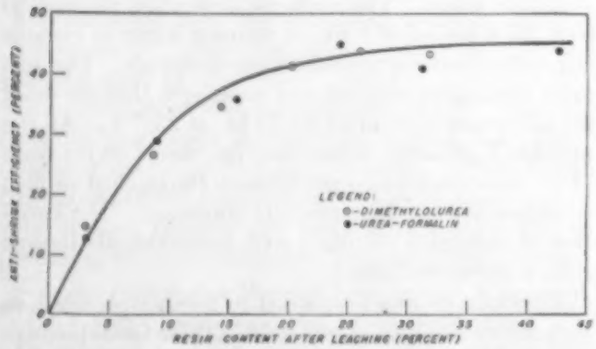
pH of system—In studying the influence of pH on the antishrink effectiveness of the urea-formaldehyde resin system, two series of solutions were prepared, both having a 2 to 1 formaldehyde to urea ratio and a resin-forming solids content of 20 percent. The first series was prepared from commercial dimethylolurea buffered at pH values of 7.0, 8.6, 9.2, 10.0; the second from a urea-formalin mix buffered at the same pH values. The treating, curing and testing procedures were the same as used in the preceding study.

Figures 1 and 2 show the results obtained with Sitka spruce. The pH values plotted are those in equilibrium with the treated wood. In all cases there is a slight drop in pH due to the acidity of the wood. Stronger buffers could have maintained a constant pH. They are, however, unnecessary to accomplish degree of stabilization of solution needed in treating Sitka spruce. More acidic woods may require use of more buffer.

Figure 1 indicates that buffering at a pH of 8.0 gave the best antishrink efficiency values, the reason being that too alkaline a solution in the range tested retards polymerization and gives a higher resin loss on leaching as is indicated in Fig. 2. On the other hand, if the solution becomes too acidic, polymerization occurs too rapidly, causing an ineffective precipitate within the cell cavities and also in the solution which practically nullifies its reuse value.

Resin content—Variations of the antishrink efficiency with resin content were studied by treating Sitka spruce cross sections with solutions having resin-forming solids concentrations of 5, 10, 15, 25 and 30 percent; all solutions being buffered at pH of 8 and having a 2 to 1 formaldehyde to urea ratio. Treating and curing conditions were the same as previously described. The previous data for 20 percent resin concentration were also included in the comparisons.

Figure 3 shows that the antishrink efficiency is almost identical for dimethylolurea and urea-formalin systems and increases rapidly with increasing resin content up to about 25 percent. Figure 3 also indicates that at the



3—*Antishrink efficiency of treated Sitka spruce is almost identical for dimethylolurea, urea-formalin systems*

higher resin contents the urea-formalin mixes are more completely fixed in the wood structure than are the dimethylolurea mixes.

Cure conditions—For studying the effect of curing conditions, such as temperature, time and relative humidity, on the antishrink efficiency, dimethylolurea and urea-formalin systems were prepared having a resin-forming solids content of 25 percent and a formaldehyde to urea ratio of 2 to 1. Both solutions were buffered at a pH of 8. Sitka spruce cross sections were treated in the usual way, air-dried for 24 hr., and then cured under conditions of increasing severity, as indicated in Table II. Cured resin-content values before leaching were between 30 and 35 percent for all specimens.

Table II indicates that there is very little resin polymerization at room temperature. Even after a month most of the resin-forming solids are leached from the wood. There is a marked difference in apparent resin content and antishrink efficiency between the specimens cured at 160° F. in a dry atmosphere and those cured at 75 percent relative humidity in a desiccator over saturated sodium chloride.

The presence of excess moisture seems to prevent the rapid drying to a moisture content below which diffusion can take place. When drying is so retarded, outward diffusion of resin-forming chemicals from the cell walls to the cell cavities occurs, followed by curing of the resin in this structure where it is ineffective in dimensional control. Even in a dry atmosphere antishrink efficiency values approaching those for oven cure were obtained only after at least 10 days curing.

Oven curing at 220° F. gave fairly good antishrink efficiency values in 48 hr., although better results were obtained with a somewhat longer period. Press curing at 320° F. gave the best antishrink efficiency values, a heating period of 10 min. being most practical. From these results it is apparent that urea-formaldehyde resins require about the same curing conditions as are used for the water-soluble phenolic-treating resins.[6, 7, 9]

The use of a heat-activated, potentially acidic catalyst to insure polymerization has been proposed.[12] These catalysts are neutral in reaction at normal room temperature, becoming acidic at higher temperatures. No information on this modification was obtained in the present investigation, but it is evident that almost complete polymerization occurs without the presence of such a catalyst, even for Sitka spruce, a wood which is not highly acidic, when the pH of the treating solution stays above 7.5 after treatment. It is doubtful that any greater antishrink efficiency could be obtained by the use of a potentially acidic catalyst although the rate of cure might be accelerated. There are a number of disadvantages to the use of such a catalyst. Some heating is required to dissolve dimethylolurea and the catalyst thus might be activated, causing precipitation of resin before treatment could be started. Furthermore, some slightly alkaline buffer, compatible with the catalyst and not interfering with its action, would have to be included to allow reuse of the solution and prevent precipitation of resin before it enters the cell-wall structure of the wood. There also is the danger that use of too much catalyst would result in gradual weakening of the product through acidic hydrolysis of the cellulose. Acid-catalyzed urea and phenolic glues have lost favor as a result of hydrolytic degradation action on the wood.

Urea-formalin treatment of oak

Because of the possibility that a more acidic wood might promote resin curing under milder conditions than those found for Sitka spruce, it was decided to try the treatment on white oak, using urea dissolved in formalin in which the resin-forming solids content was 25 percent, and the formaldehyde to urea ratio was 2 to 1 under three different pH conditions: a) unbuffered; b) buffered, as in the (*Please turn to page 202*)

Table II.—Effect of Varying Curing Conditions Upon the Antishrink Efficiency of Sitka Spruce

Cure condition			*Dimethylolurea series*		*Urea-formalin series*	
Temperature	*Relative humidity*	*Time*	*Resin content after leaching*	*Antishrink efficiency*	*Resin content after leaching*	*Antishrink efficiency*
° F.	*%*	*Days*	*%*	*%*	*%*	*%*
Approx. 70	Approx. 30	10	1.9	7.4	5.7	10.7
		20	4.0	10.0	7.5	17.3
		30	4.4	8.1	8.1	13.3
160	75	5	23.1	8.7	27.4	10.0
		10	22.0	16.1	26.9	20.0
		30	22.3	18.8	26.0	20.6
160	Approx. 2	10	14.0	26.8	18.9	35.3
		20	16.0	31.5	21.7	38.0
		30	15.2	30.2	21.1	37.4
220	Approx. 0	2	22.7	38.2	27.5	40.6
		10	25.2	43.0	29.8	48.0
		20	26.9	47.6	30.9	48.6
		Minutes				
320	Approx. 0	5	26.5	40.3	31.6	50.6
		10	28.0	43.6	31.1	51.3
		20	27.3	43.0	31.8	52.0
		40	27.8	44.3	32.8	52.6
		60	27.4	44.3	33.3	52.0

Thermosetting rubber-resin compounds

by A. F. SHEPARD and J. F. BOINEY*

PHENOLIC resins and rubber resemble each other in one respect. Both can be vulcanized or cured. In most other respects they differ, and the virtues of each material are lacking in the other. As a simple example, phenolics mold well but have none of the toughness of rubber. Why not add rubber to a phenolic molding compound to correct this deficiency? Conversely, while rubber is tough, its molded finish, speed of cure and resistance to heat, oxidation and solvents compare unfavorably with phenolics. Then why not add phenolic resin to rubber to correct these deficiencies and to serve as a vulcanizing agent as well?

In spite of the potential advantages of rubber-resin compounds and the considerable research done on them, the early work[1] led to little of practical value. Thermosetting phenolic resins did find limited use in certain hard rubber compounds for friction materials, but this was about the extent of their application. More recently, in Holland, Wildschut[2] and later Van der Meer[3] succeeded in vulcanizing rubber with certain phenolic derivatives. Most of their work was done with natural rubber, and since the war interfered with the flow of natural rubber supplies on the continent it is impossible to estimate just what were the practical values of their findings.

In the United States phenolic resins are now finding considerable use with synthetic rubbers. Especially good results have been obtained by the combination of Buna N or Neoprene-type synthetic rubbers with Durez 12687 resin. In the combination of this resin with these synthetic rubbers many of the valuable properties of both rubber and resin are preserved. Added to rubber in moderate amounts, the resin facilitates processing of the rubber. The compounds mold into products resembling ordinary soft or hard vulcanized rubber—the molded finish being improved and the cure time reduced in the case of hard stocks. Further, these rubbers when added to molding compounds formulated with Durez 12687 impart greatly increased toughness to the products without causing serious sacrifice of moldability.

The phenolic resin referred to differs markedly from the phenolic vulcanizing agents reported by Wildschut and Van der Meer. The general properties of this resin and the difference in its curing action will first be discussed. The properties of some simple rubber-resin compounds containing no sulfur or curing agent will then be reported and, finally, some data will be given on the properties of rubber-resin compounds containing filler and vulcanizing agents.

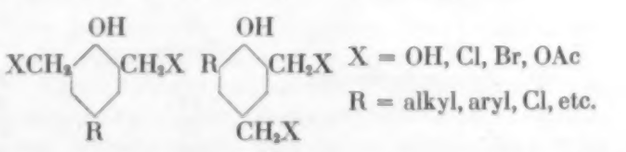
Properties of the phenolic resin

Durez 12687 is a finely powdered solid. It is thermosetting, becoming quite fluid when heated to about 80° C. and curing in 20 to 30 sec. in a thin film on a hot plate at 165° C. The resin owes its thermosetting properties to the presence of hexamethylenetetramine. It is easily incorporated in rubber by the usual techniques. Due to the fluidity of the resin when first melted it serves as a temporary plasticizer during the early stages of milling or processing. The resin is compatible in all proportions with various Buna N (butadiene-acrylonitrile) rubbers and with the Neoprenes.

As will be shown later, simple mixtures of this resin and some synthetic rubbers are curable. The resin is a vulcanizing agent for the rubber, at least in a mechanical sense. No sulfur or accelerator are required and the rubber-resin compounds containing 25 to 35 percent resin are converted under heat from a plastic condition to non-plastic elastic products with tensile strengths as high as 2000 to 3000 p.s.i. It is not known whether this is vulcanization in a chemical sense involving chemical reaction between rubber and resin analogous to a chemical reaction between rubber and sulfur in sulfur vulcanization. At least the use of the phenolic resin permits the preparation of sulfur-free products resembling vulcanized rubber.

There is an important difference between the vulcanizing action of Durez 12687 and the action of the phenolic derivatives of Wildschut and Van der Meer on natural rubber. Durez 12687 contains hexamethylenetetramine as curing agent. Wildschut used a one-step *p-tert*-amylphenol-formaldehyde resin and certain commercial resins such as Albertol 142 R, which he believed chemically similar, as curing agents. He found that hexamethylenetetramine either prevented or greatly retarded their curing action on natural rubber. He also found that Perbunan and Buna S could be vulcanized with synthetic resin and stated that there seemed to be no fundamental difference between natural and synthetic rubber as far as vulcanization with resins is concerned.

Van der Meer used compounds of the types:



and was able to vulcanize rubber quite successfully with

* Durez Plastics & Chemicals, Inc.

[1] C. Ellis, "The Chemistry of Synthetic Resins," Vol. I, 434–436 Reinhold Publishing Co., New York (1935).

[2] A. J. Wildschut, "Mededeelingen van de Rubber—Stichting No. 36," 12 pages (March 1943). Rubber Chemistry and Technology *19*, 86–99 (1946).

[3] S. Van der Meer, Rec. trav. Chim. *63*, 147–169 (1944). Rubber Chemistry and Technology *18*, 853–873 (1945).

a number of them. He likewise observed that the addition of hexamethylenetetramine to 2,6-dimethylol-4-methylphenol completely prevented the vulcanization which occurs when this phenol is used alone. This was explained as a corollary of his methylene quinone theory of vulcanization. He said cresol-hexamethylenetetramine resin had no vulcanizing power in natural rubber.

At the present time, it is impossible to give an adequate explanation of the curing action of 12687 resin.

Rubber-resin compounds containing no sulfur

The data which follow were obtained with the commercial butadiene-acrylonitrile copolymers, Hycar OR-25, OR-15 and OR-5. The three rubbers are said to be a series of copolymers in which the butadiene content is progressively reduced and acrylonitrile progressively increased, the OR-5 rubber having the highest nitrile content.

Low resin compounds—Up to about 50 percent resin these compounds are rubbery or leathery. These compounds were made by first breaking down the rubber on differential rolls at 30 to 50° C. and then milling in the resin. No sulfur, accelerator, filler, or other ingredients were added. Test specimens were die cut from $^1/_{16}$ in. thick sheets, cured 30 min. at 100 lb. steam.

Figures 1 and 2 show the effect of increasing resin content on tensile strength (Fig. 1) and elongation (Fig. 2). At 25 to 35 percent resin with Hycar OR-15 or OR-5 the cured products resemble vulcanized rubber, having tensile strengths in the range 1500 to 3000 p.s.i. with elongations of 100 to 450 percent. The molded finish of the materials also improves as resin content increases. Up to about 50 percent resin the compounds have some extensibility and might well be classed as soft rubber stocks.

High resin compounds—As resin content is increased above 50 percent, the compounds are no longer extensible and rubbery (Fig. 2). The effect of the rubber is, however, still pronounced on the impact strength of the compound, the Izod impact of such materials being as much as three times greater than in the absence of the rubber. The deflection of a standard flexural test bar also may be three or four times as great as for the phenolic resin alone; that is, the phenolic material is made less rigid (lower in elastic modulus) by the incorporation of rubber. The value of phenolic molding compounds with greater impact strength and less rigidity is obvious to those familiar with molding.

Table I illustrates the effect of rubber on the impact strength and flexural deflection of the phenolic molding compound which was just discussed. Compounds listed here were prepared by breaking down the rubber on

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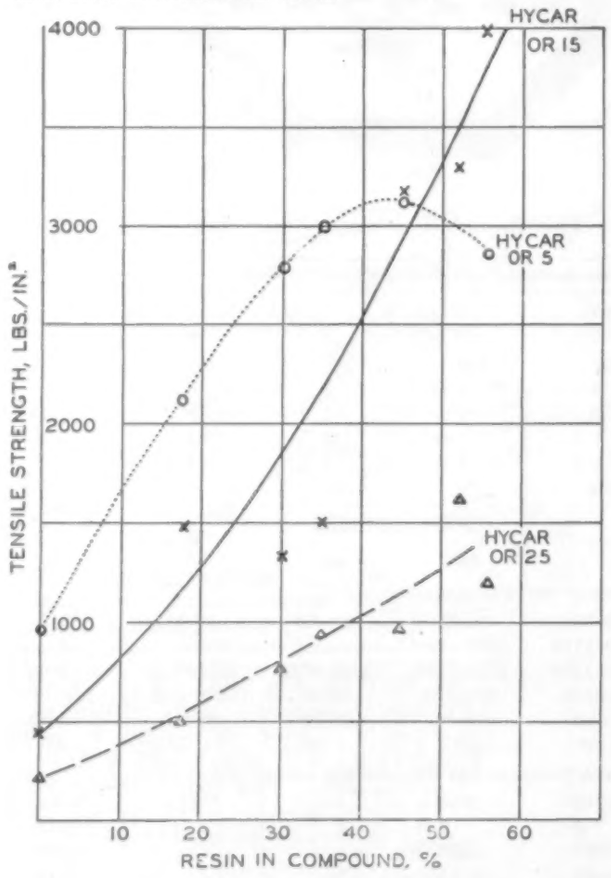
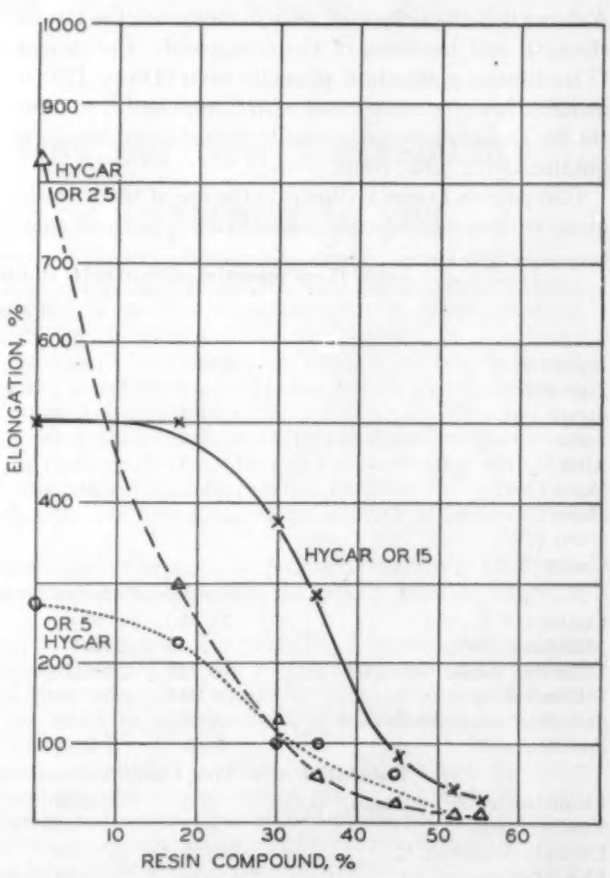


1—A chart showing the tensile strength versus resin content of phenolic resin and synthetic rubber compounds (no sulphur or accelerator)



2—This chart depicts elongation versus resin content for phenolic resin and synthetic rubber compounds (no sulphur or accelerator)

Table I.—Effect of Addition of Synthetic Rubber on Properties of Phenolic Molding Compounds

Composition of molding compound				Flexural strength	Flexural deflection	Izod impact strength
Phenolic resin Durez 12687	Synthetic rubber: Hycar OR-25	Synthetic rubber: Hycar OR-15	Woodflour			
				p.s.i.	mils	ft.-lb./in. of notch
100	...	...	100	13,000	74	0.33
70	30	...	100	8,500	95	0.69
55	45	...	100	6,300	134	0.98
70	...	30	100	11,000	115	0.53
55	...	45	100	9,000	190	0.75

differential rolls at 30 to 50° C., incorporating the resin and finally milling in an amount of plastics-grade woodflour equal in weight to the total weight of resin and rubber. The products were ground and molded into test pieces according to the usual procedures used for phenolic plastics. A compound made from the resin and woodflour without rubber was used as a control.

Compounds containing sulfur and accelerators

Conventional rubber compounding ingredients may also be used in rubber compounds containing 12687 resin. The data in Table II illustrate the use of the resin as a rubber compounding ingredient and show the excellent balance of high tensile strength, hardness, elongation and low temperature flexibility obtainable.

Comparison of Compounds B and C with Compound A shows the effect of added resin in increasing the tensile strength and hardness of the compound. Compound G containing a standard phenolic resin (Durez 175) is included here for comparison with Compound B to show the far greater increase in tensile strength and hardness obtained with 12687 resin.

Compounds D and E illustrate the use of 12687 Resin along with carbon black (Gastex SRF). In these compounds the resin addition makes for easy processing and yet permits the development of the high tensile strengths which are characteristic of the various carbon black stocks.

Applications

In the softer stocks, rubber-resin combinations are extensively used because the resin acts as a plasticizer in the early states of processing without decreasing the hardness and tensile strength of the final cured stocks.

One of the larger volume uses of Buna N-Durez 12687 stocks has been in shoe soles because of the exceptionally good abrasion resistance. A typical formulation used for evaluation purposes by the V. L. Smithers Laboratories is as follows:

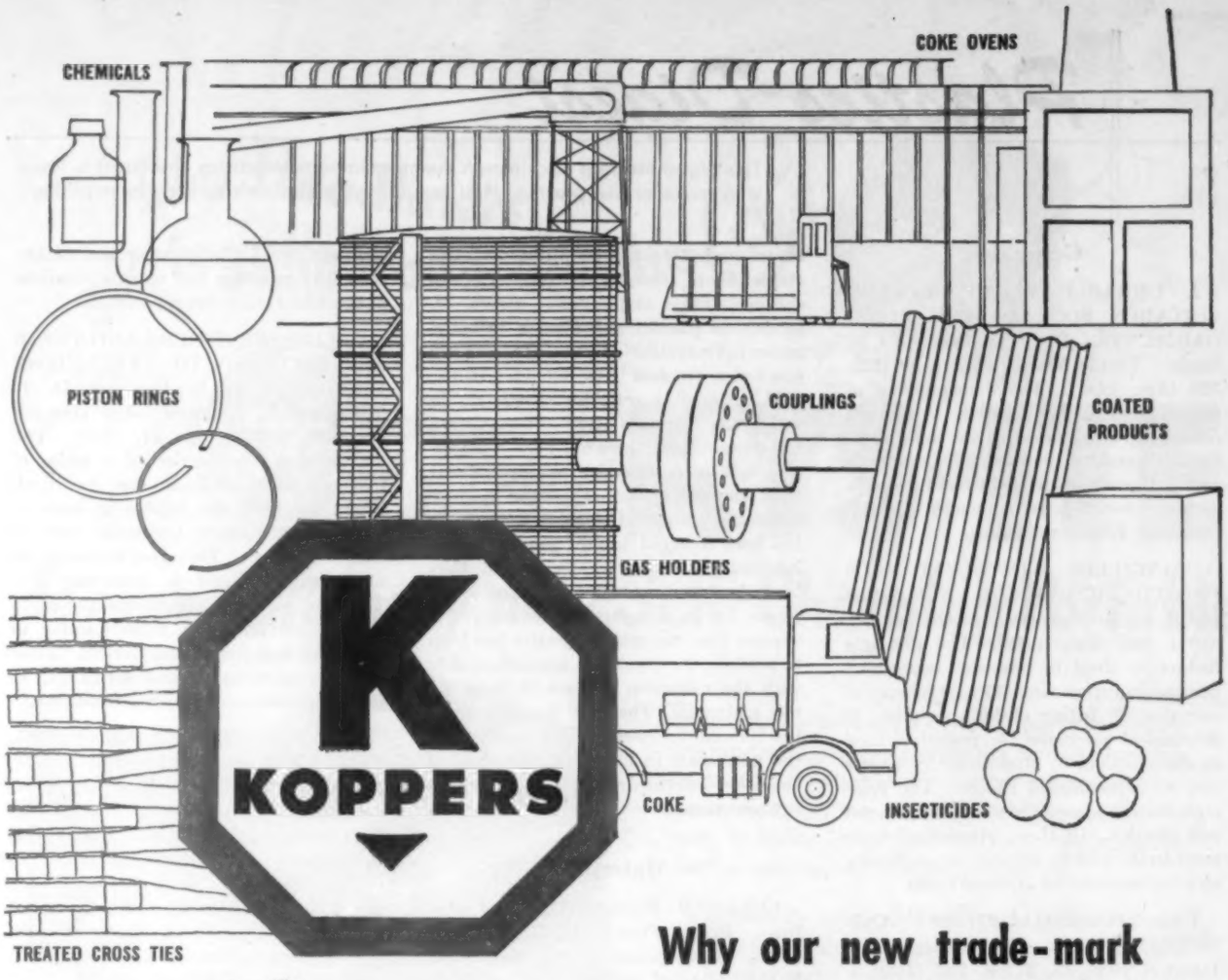
Hycar OR-25	100
Zinc oxide	5
Stearic acid	1.5
Sulfur	1.5
Altax	1.5
Kalvan	60
Silene EF	20
Durez 12687	20

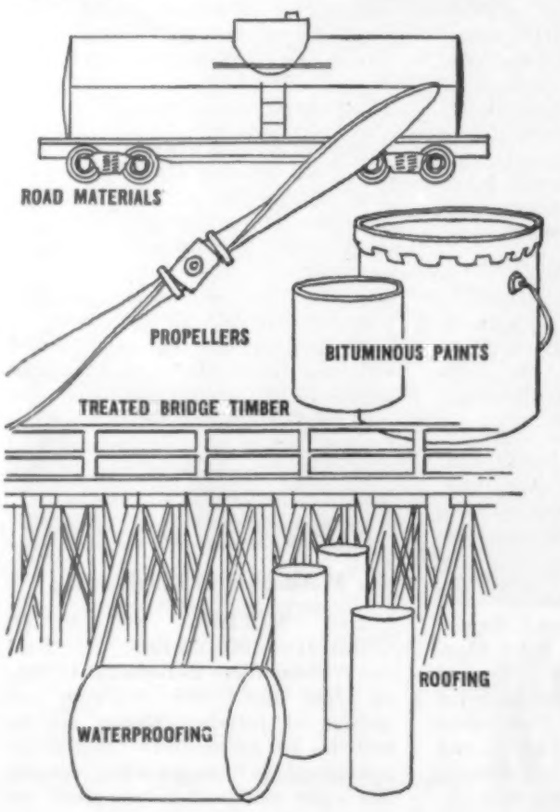
This formulation was (*Please turn to page 210*)

Table II.—Properties of Synthetic Rubber Compounds Containing Phenolic Resin[a]

	Composition						
	A	B	C	D	E	F	G
Hycar OR-25	100	100	100	100	100	100	100
Zinc oxide	5	5	5	5	5	5	5
Stearic acid	1.5	1.5	1.5	1.5	1.0	1.0	1.5
Sulfur	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Altax	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Durez 12687	...	50	20	20	75	...	...
Durez 175	...	...	...	...	...	...	50
Durez 12707	...	...	...	...	...	75	...
Gastex (SRF)	...	...	...	50	60	60	...
Original Physical Properties of the Vulcanizate							
Cure at 310° F., min.	30–45	30–45	30–45	30–45	30–45	30–45	30–45
Modulus at 300%	...	2400	1050–1110	2800	...	3000	650
Ultimate tensile strength, p.s.i.	300–325	2400–2600	1240–1330	2750–2830	3925–3925	3225–3300	1025–825
Ultimate elongation, %	390–430	300–280	330–340	260–270	40–40	270–210	570–290
Shore hardness of tensile sheet	48–50	92–93	63–64	78–80	98–98	97–97	64–64
Specific gravity	1.03	1.08	1.08	1.17	1.21	1.22	1.08
Properties of 45 Min. Cured Vulcanizate after Aging in Air Oven 70 Hr. at 212° F.							
Ultimate tensile strength, p.s.i.	375	2600	1240	2740	...	...	1100
Tensile change, %	+15	0	0	0	...	...	+33
Ultimate elongation, %	320	180	280	220	...	...	250
Elongation change, %	−26	−36	−15	−15	...	...	−14
Shore hardness	49	96	70	82	...	...	70
180° bend	OK	OK	...	...	...	...	OK

[a] This test information was developed by the Technical Service Laboratory of the Hycar Chemical Company.





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General

A DURABLE FLAMEPROOFING SUITABLE FOR COTTON OUTER GARMENTS. K. S. Campbell and J. E. Sands. Textile World *96*, 118–19, 222, 226 (Apr. 1946). The flameproofing of cotton garments is discussed. A formula containing urea-formaldehyde resin, chlorinated paraffins, oil-modified alkyd resin and antimony oxide dissolved in hydrocarbon solvents is recommended for this purpose. Eleven references.

PRINCIPLES INVOLVED IN PROSTHETIC DEVICES. F. P. Kreuz and H. H. Montgomery. Mech. Eng. *68*, 630–1, 636 (July 1946). The principle factors involved in problems concerning prosthetic devices are: 1) case history of amputee, 2) fitting of limb or part, 3) mechanical principles, 4) materials used in construction, 5) alterations by wearer and 6) psychological effects. The principle materials used are wood, fiber, metal and plastics. Of these, plastics offer the most fertile field for research in developing an ideal material for artificial limbs.

UNSUPPORTED FILMS AND SHEETINGS. C. W. Patton. Am. Dyestuff Rep. *35*, 277–8, 282 (June 3, 1946). The manufacture of unsupported plastic films and sheetings is discussed. The materials selected depend on the type and application of the product. One of the most important problems is the type and amount of plasticizer to use. Colors and stabilizers must also be considered. The five principal methods for making plastic films and sheetings are calendering, solution casting, dispersion casting, solution extrusion and dry extrusion.

PLASTIC MONOFILAMENTS. M. R. Radcliffe. Am. Dyestuff Rep. *35*, 279 (June 3, 1946). Plastic monofilaments are usually made of nylon, polyvinylidene chloride, polyvinyl chloride and polyethylene. The average plastic monofilament contains 90 percent resin, 2 percent colors and stabilizer and 8 percent plasticizers and lubricants. The steps in making the filaments are: 1) preparation for extrusion, 2) extrusion, 3) orientation and 4) conditioning. Properties and applications of monofilaments are discussed.

SYNTHETIC FIBER DEVELOPMENTS IN GERMANY. Textile Research J. *16*, 149–159, 191–200 (Apr., May 1946). The results of an investigation of the synthetic fiber industry by a combined Anglo-American technical group are summarized in this report. The topics include general textile conditions, viscose staple fiber, the acetate process, fully synthetic fibers and cellulose ethers. A section on plastics and films is included under fully synthetic fibers. The general conclusion reached is as follows. In the field of applied cellulose chemistry, in which the Germans were outstanding a few decades ago, there has been a noticeable lack of noteworthy accomplishment from the standpoint of getting a more satisfactory fiber. Relatively little effort has been directed toward improving the inherent quality of staple; rather, they have depended upon various after-treatments for improvements in quality. It appears that the entire objective has been to produce the maximum amount of fiber with the minimum amount of imported raw materials. The Nazi demands upon the German technicians have resulted for the most part in increasing the scale of operation and the development of massive equipment units.

Materials

LEATHER RESINOID. A. Colin-Russ. British Plastics *18*, 256–62 (June 1946). Seven grades of resin made from leather proteins are described. Two of these are modified with phenol-formaldehyde and urea-formaldehyde resins. The formulation, properties and methods of handling each grade are discussed. Blends with other resins are also included. These resins are suggested for making mats, hood coatings, cycle grips and pedals, bottle seals, beakers, trays, shoe soles, coated fabrics, floor coverings. Seven references.

ETHERS AND ETHER-ESTERS OF LAC AND THEIR POLYMERIZATION. B. S. Gidvani and N. R. Kamath. London Shellac Research Bureau, Tech. Paper No. *28*, 19 pp. (1945). The preparation and properties of lac ethers and lac ether-esters are described.

SILICONES. D. G. McNabb. Can. Chem. Process Ind. *30*, 30–2 (Apr. 1946). The history, structure, synthesis and properties of silicone resins, oils, greases, films and rubbers are reviewed.

MIXED ALLYL ETHERS OF STARCH. M. Hamilton and E. Yanovsky. Ind. Eng. Chem. *38*, 864–6 (Aug. 1946). A number of mixed ethers of starch containing both allyl and saturated alkyl groups were prepared. These ethers do not contain free hydroxyl groups, and some of them are soluble in aliphatic hydrocarbons, in which previously described types of allyl starch are not soluble. Solubility relations and specific rotations of the mixed ethers are reported.

CELLULOSE ETHERS AND THEIR APPLICATION TO CELLULOSE FIBERS. R. T. K. Cornwell, D. T. Milne and D. S. Porter. Am. Dyestuff Rep. *35*, 304–5 (June 17, 1946). The synthesis and properties of a series of hydroxyethyl celluloses are described. These materials are soluble in aqueous solutions of sodium hydroxide but insoluble in water. They vary in the degree of substitution and in molecular size. They are used to treat cellulosic fibers to make them linen-like, more durable to wear and laundering, and lintless. They are also used to control shrinkage, to carry pigments and as dyeing assistants.

LOW-PRESSURE LAMINATING. E. G. Williams. British Plastics *18*, 274a–278 (June 1946). A new low-pressure laminating resin developed in England is described. The resin contains no free styrene. Benzoyl peroxide is used to catalyze the cure after the two parts are mixed. Air inhibits the cure. The usual contact technique of laminating is used. Glass fabric laminates made with this resin have a tensile strength of 32,500 p.s.i., a flexural strength of 40,000 p.s.i., a flexural modulus of elasticity of 2,000,000 p.s.i., a density of 1.72 and a water absorption of 0.42 percent in 24 hours.

NEW PLASTICS FROM COAL TAR. J. I. Jones. British Plastics *18*, 286–9 (July 1946). The production of acenaphthene from coal tar and its conversion to acenaphthylene by dehydrogenation are described. Acenaphthylene can be polymerized to produce a series of resins with molecular weights as high as 90,000. Acenaphthylene can be copolymerized with many unsaturated chemicals such as styrene, methyl methacrylate and vinyl carbazole to produce resins. The possible forms in which these resins may find applications include films, coatings, adhesives, impregnants and molding powders. Nine references.

Molding and fabricating

THE MOLDING OF VINYL CHLORIDE POLYMERS. K. Tensi and W. Zebrowski. Brit. Plastics *18*, 238–52 (June 1946). The properties and molding of polyvinyl plastics are described. The information is based on the practices of the German plastics industry. The topics considered include plastic be-

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CLOSE-UP OF KYS-ITE 3 PART COMBINATION:

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havior, flow properties, chemical stability, working conditions, pressure and molding processes. Various items made by each process are described. The processes described include hot compression, compression-injection, injection, impact-compression and impact-injection.

CENTRIFUGAL CASTING. T. A. Dickinson. Can. Plastics *4*, 13–14 (July 1946). Hot liquid phenolic resins are cast by a centrifugal process. Although air bubbles are easily removed by this technique the fillers and pigments remain well dispersed.

Applications

LAMINATING ADHESIVES AND THEIR APPLICATIONS. A. Biddle. Paper Trade J. *122*, 34–40 (June 6, 1946). The increasing number of adhesives together with the laminating problems involved are developing many problems for the adhesive manufacturer, the laminator and the machine maker. One of the principle causes is the reluctance of adhesive manufacturers to give information concerning their formulations and specific uses for their products. The various types of adhesives are discussed from the viewpoint of formulation and the function of the ingredients used. The base materials discussed include polyvinyl acetate, butadiene-styrene copolymer, vegetable gums, starch, dextrins, zein, polyvinyl alcohol, soybean flour, casein animal glues, silicones, bitumens, waxes, polyisobutylenes, polyamides, cellulose derivatives, vinyl resins, chlorinated rubbers and urea-formaldehydes. Water dispersions, solvent-types, pressure-sensitive types and hot melts are considered.

LOW-DENSITY CORE FOR AIRCRAFT LAMINATE COMPONENTS. R. E. Maier. Aviation *45*, 72–3 (July 1946). Cellular cellulose acetate is sandwiched between plywood, metal sheet or glass-cloth faces to make aircraft parts with unique properties. Suggested applications, methods of fabrication and physical properties of the core material are described. Applications include flooring, bulkheads, furnishings, doors, instrument and food storage cases, control sections.

THERMOSETTING ADHESIVES FOR WOOD. P. C. Fuller and R. L. Hiller. Product Eng. *17*, 84–9 (July 1946). The formulation, working characteristics and bonding conditions of urea-, melamine-, phenol- and resorcinol-formaldehyde resinous adhesives for plywood and wood assemblies are described in detail. Test methods, properties and applications of the plywoods made with these resins are also considered.

IMPREGNATING MAGNESIUM CASTINGS. S. A. Moore. Iron Age *157*, 76–80 (Mar. 14, 1946). The materials which have been used for impregnating magnesium castings are reviewed. These include sodium silicate, varnishes, styrene-oil copolymers and a new resin-styrene copolymer. The method of using this new resin, its properties and the properties of magnesium castings impregnated with this resin are described. This new resin-styrene copolymer is superior to the other resins proposed for this purpose.

UREA RESINS IN ORTHOPEDIC SURGERY. H. A. Collinson. British Plastics *18*, 253–5 (June 1946). Supports for broken bones and spinal supports are made by dipping bandages in cold-setting catalyzed urea-formaldehyde resins, applying the bandages to the part needing support, and allowing the resin to cure. Flannel bandages are recommended since the low pH required to cure the resin weakens cotton. These supports have excellent fit, are hard, will withstand hot water of bath temperature, are easily removed by cutting, are light in weight, readily applied and do not irritate the skin.

Coatings

THERMAL POLYMERIZATION OF DRYING OILS. H. E. Adams and P. O. Powers. J. Applied Phys. *17*, 325–37 (May 1946). A statistical analysis of the thermal polymerization of drying oils is made, and equations are derived which predict the amount of a specific polymer present as a function of the extent of reaction and the original composition of the oil. Several samples of oils were heat bodied to test the validity of this analysis. Certain discrepancies are apparent. The presence of an intrapolymer is postulated to explain these discrepancies. Indirect evidence for the presence of such a compound is presented. Additional studies of the heat polymerization of drying oils were made by conducting the polymerization in dilute solution. After the reaction was carried out, the solvent was removed and the properties of the oils compared with oils similarly treated without solvent. It was found that iodine values of the oils are substantially the same regardless of the concentration of oil and depend only on the time and temperature of heating, but that the viscosity decreases with lower concentration of the oils. This behavior substantiates the formation of an intrapolymer. By using the values at various concentrations it may be possible to estimate the extent of intrapolymer formation in heat bodied oils.

WATER IMMERSION TESTING OF METAL PROTECTIVE PAINTS. W. W. Kittelberger and A. C. Elm. Ind. Eng. Chem. *38*, 695–9 (July 1946). A paint system consisting of one coat of zinc chromate primer and one coat of low gloss, alkyd hull paint was applied to various substrate materials and immersed for varying periods of time in distilled water and in solutions of sodium chloride and sucrose with osmotic pressures of 6 to 30 atmospheres. The rate and degree of water absorption and blistering were determined by extensive measurements of weight and volume changes, and by visual examination. Regardless of the nature of the substrate and immersion bath, water absorption and blistering increased with increasing immersion time but decreased markedly with increasing osmotic pressure of the bath. Factual evidence developed here establishes that water is transferred through the face of the paint film under the influence of, and at a rate determined by, the difference in osmotic pressure of the bath solution and of the solution formed within the paint system by the water absorbed. If osmotic pressure of the external solution is high enough, blistering does not take place. The minimum osmotic pressure of the external solution required to prevent blistering varies with the nature of the substrate, and is suggested as a basis for measuring the adhesion level of the test coating for the substrate material. Some evidence is presented which indicates that water absorption does not take place by way of pores but by a process which is related to actual solution.

RAPID PRODUCT FINISHES. P. O. Blackmore. Paint Varnish Production Mgr. *25*, 311–14 (1945). The history of rapid drying coatings is given. The characteristics of urea-alkyd resinous coatings for wood are described.

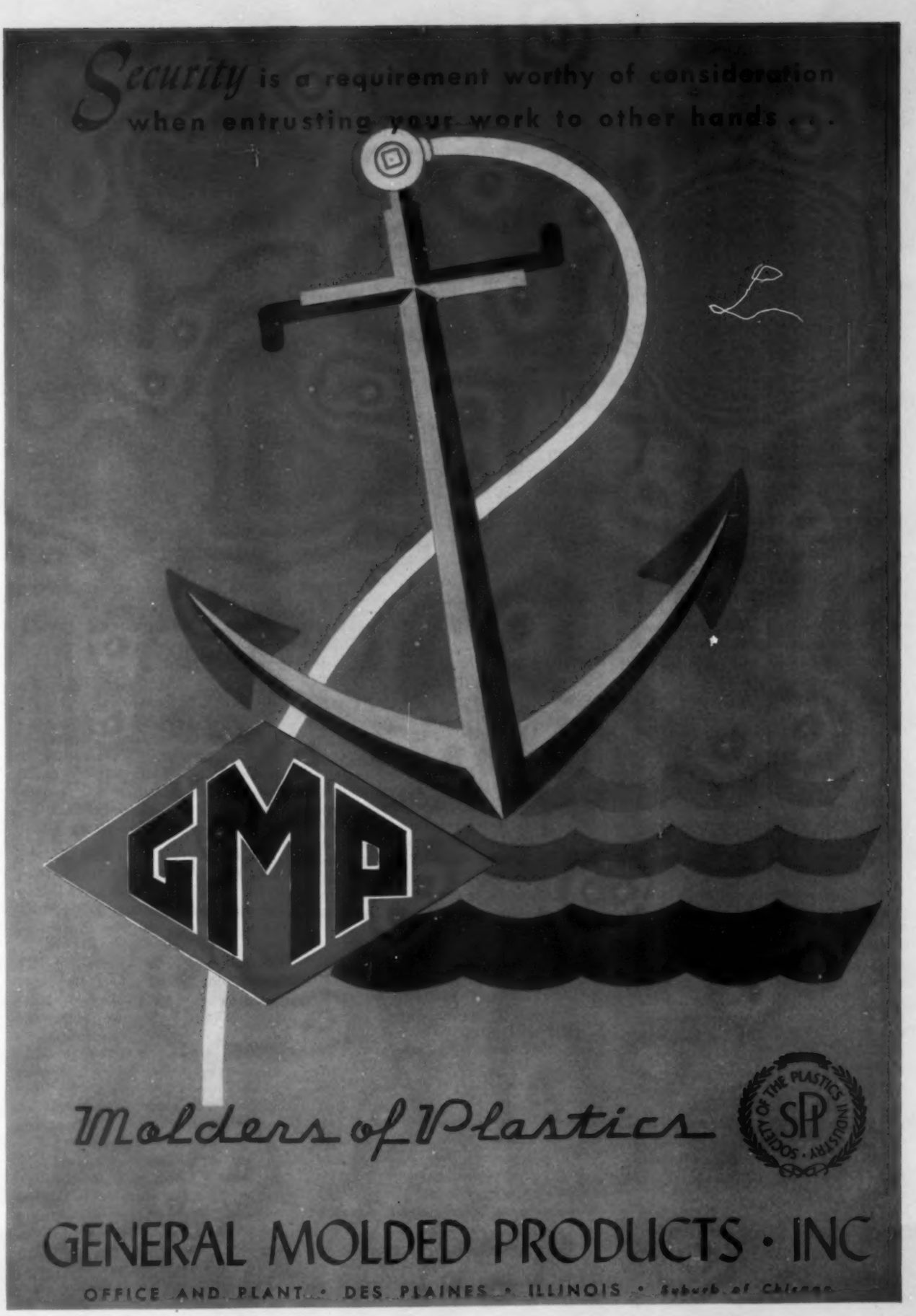
ULTRA-FINE PIGMENT PARTICLES BASIS OF NEW LACQUER. Chemical Industries *59*, 57 (July 1946). A new method of transferring pigment particles from water to the lacquer medium without intermediate filtering, drying and grinding is the basis of a new lacquer developed by Du Pont. The new technique permits the use of ferric hydroxide as a pigment, heretofore impracticable.

PERMANENTLY COLORED VARNISHES. W. S. Penn. Paint Manuf. *16*, 39–42 (1946). Synthetic resins are permanently colored by using dye which forms homopolar bond with polymer molecule.

RECENT DEVELOPMENTS IN WOOD FINISHES. P. S. Kennedy. Mechanical Eng. *68*, 212–14 (March 1946). The properties needed in satisfactory wood finishes and recent developments in this field are reviewed.

FORMULATION OF HEAT-RESISTANT PAINTS. H. W. Rudd. Paint Manuf. *15*, 343–7 (1945). The formulation of heat-resistant coatings is discussed. It is suggested that a heat-resistant coating should withstand a minimum temperature of 250° C. for a reasonable time.

COMPARISON OF RECENTLY DEVELOPED PLASTICIZERS FOR NITROCELLULOSE. Am. Paint J. *30*, No. 6A, 16D–16G (1945). Plasticizers for cellulose nitrate are discussed. Properties of 49 plasticizers are given.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Technical Briefs

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments.

Engineering

RELATION BETWEEN THE IMPACT AND FLEXURAL TESTS FOR MOLDED PLASTICS. L. E. Welch and H. M. Quackenbos, Jr. Trans. A.S.M.E. *68*, 547–56 (July 1946). A theoretical treatment of the phenomena of impact is presented which indicates that rupture under dynamic stress-strain conditions results from the same basic considerations as those governing static or flexural failure. This thesis is proved experimentally by reducing the problem to one of stress rather than the usual method of energy evaluation. When this is done with the aid of newly developed high-speed electronic techniques, it is conclusively demonstrated that impact loading is merely a special case of static loading whereby the stress-strain conditions are identical except for a slight elevation in strength under dynamic conditions. No perceptible variation in the modulus of elasticity is encountered under dynamic stressing compared with static loading. It is shown that the existing methods of impact-strength evaluation such as the standard Izod and Charpy tests lead to erroneous results since the machines in use are apparently of too light construction, and the technique is over simplified. In the static flexural test the energy absorption by the specimen is virtually 100 percent. In the standard impact tests the energy absorption by the specimen varies from 10 to 50 percent of the indicated energy loss of the pendulum. The remainder of the energy is lost in the machine and in kinetic energy of the broken parts of the specimen. The ability of the standard notched-bar impact tests to differentiate between materials of like tensile and flexural strength properties is primarily due to the large variation in notch sensitivity in these materials. Static flexural test techniques employed to evaluate the energy fracture and notch sensitivity for molded thermosetting plastics are concluded to be sufficient for predicting the service characteristics of such materials under both static and impact loading. The theoretical concepts developed are not restricted to the testing of plastics but may be applied to the testing of metals as well as all other materials of construction.

THREE LONG-TERM WEATHER TESTS ON PLYWOOD GLUES. R. A. G. Knight and L. S. Doman. Wood *10*, 309–11 (1945). Plywood panels made with various woods and adhesives were tested 1) by burying partially in sand, 2) by immersing partially in water and 3) by exposing to the weather above ground. Those made with phenolic resins were in good condition after 5 years' exposure. Mixtures of blood and phenolic resins were less satisfactory and urea resins still less. Extended urea, casein, blood and starch adhesives failed early and therefore, were judged unsuitable for exterior applications.

Chemistry

MECHANISM OF PLASTICIZATION OF CELLULOSE ACETATE BY TRIPHENYL PHOSPHATE. G. Champetier and P. Clement. Compt. rend. 222, 92–4 (1946); Chem. Abstracts *40*, 3298 (June 10, 1946). In the plasticization of cellulose acetate with triphenyl phosphate there is no solvation but instead a plasticization by insertion or intramolecular penetration.

EFFECT OF MOLDING PRESSURE AND RESIN ON RESULTS OF SHORT-TIME TESTS AND FATIGUE TESTS OF COMPREG. W. N. Findley, W. J. Worley and C. D. Kacalieff. Trans. A.S.M.E. *68*, 317–27 (May 1946). Six samples of compressed-impregnated plywood were tested for static tension, static compression, static torsion and rotating-beam type of fatigue characteristics. The samples were made from three resins at two different molding pressures. The strength characteristics of the samples molded at 1500 p.s.i. were higher than that of those molded at 600 p.s.i. The water absorption decreased with an increase in the molding pressure.

FORMATION OF IONIZED WATER FILMS ON DIELECTRICS UNDER CONDITIONS OF HIGH HUMIDITY. R. F. Field. J. Applied Phys. *17*, 318–25 (May 1946). When a dielectric is placed in an atmosphere of 100 percent relative humidity an ionized film of water forms, whose conductivity at the end of one minute is within a factor of ten of its equilibrium value, which is usually attained within an hour. This equilibrium conductivity ranges from essentially zero for certain hydrocarbon waxes, silicone resins and silicone-treated glass to 100 micro-ohms for ordinary glass and quartz. The ionized water film also produces interfacial polarization at its interface with the dielectric, which produces a marked increase in both capacitance and dissipation factor at audiofrequencies. This polarization builds up in the same manner as the conductivity. Its relaxation frequency appears to be in audio-range.

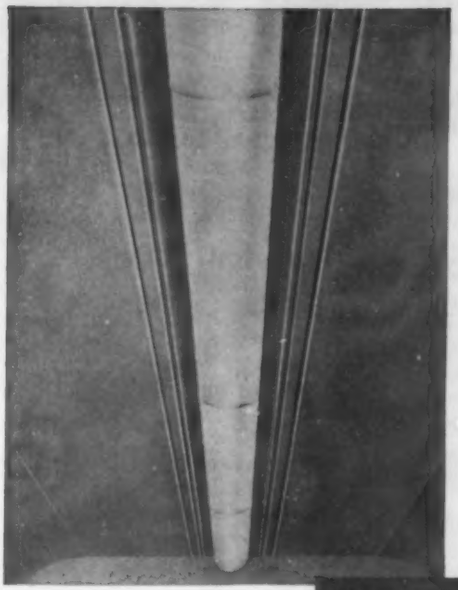
DETERMINATION OF CATALYST FRAGMENTS IN POLYMERS BY ABSORPTION IN THE ULTRAVIOLET. A. Katchalsky and H. Wechsler. J. Polymer Sci. *1*, 229–30 (May 1946). The determination of catalyst fragments in methyl methacrylate polymers is found by ultraviolet absorption.

POLYMERIZATION OF ALLYL METHACRYLATE BY MEANS OF ULTRAVIOLET RADIATION. E. R. Blout and B. E. Ostberg. J. Polymer Sci. *1*, 230–1 (May 1946). Allyl methacrylate is polymerized by exposing the monomer containing 0.3 percent benzoyl peroxide to ultraviolet radiation. This method is applicable to unsymmetrical multifunctional monomers.

Properties

RHEOLOGICAL SYSTEMATICS. M. Reiner. Rheol. Bull. *16*, 53–68 (1945). Only three ideal materials are needed for a rheological system, namely, Hookean solid, Newtonian liquid and St. Venant plastic. All materials can be expressed in terms of these three. There are five fundamental rheological properties; namely, viscosity, elasticity, plasticity, dilatancy and strength. Most other properties can be derived from these five.

TEMPERATURE DEPENDENCE OF WATER VAPOR PERMEABILITY. P. M. Doty, W. H. Aiken and H. Mark. Ind. Eng. Chem. *38*, 788–91 (Aug. 1946). A glass cell is described for the measurement of the permeability and diffusion constants of vapors in film materials. The temperature dependence of the permeability constant was measured for homogeneous films or unoriented polystyrene, oriented polystyrene, commercially cast polyvinyl chloride acetate, laboratory-cast polyvinyl chloride acetate, polyvinyl chloride, calendered polyethylene, cast polyethylene, rubber hydrochloride and polyvinylidene chloride. In all cases there is an exponential dependence of the constant on absolute temperature. The results show a wide range of behavior in this respect. The magnitude of this temperature dependence varies so much from one material to another that the performance of a given packaging film cannot be predicted with certainty at one temperature on the basis of measurements at another temperature. If such predictions



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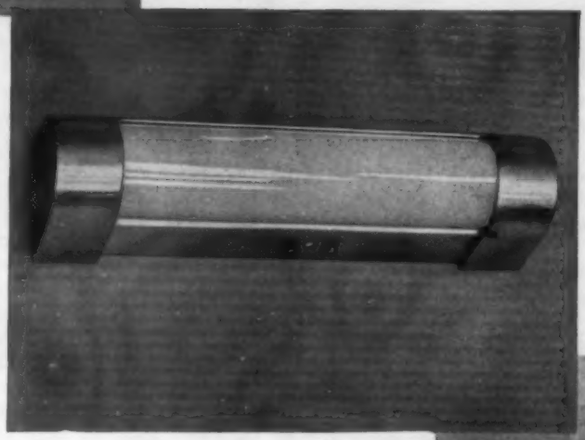

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are desired, measurements of permeability must be made for at least two temperatures. It is clear that ignorance of the temperature dependence of permeability can be sufficient reason for lack of agreement among various testing methods which do not require the same temperature. In the films studied the permeability constant decreases and the energy of activation for permeation increases as the amount of crystallinity in the polymer increases. The effect of crystallization of natural rubber on the permeability constant is shown. The temperature dependence of both permeability constant and diffusion constant was measured for the system water-polyvinyl chloride. This permitted evaluation of the energy of activation for permeation and diffusion, and also calculation of the heat of solution. This procedure verified the resolution of permeability into diffusion and solution of water vapor.

Testing

PHENOLIC RESIN GLUE LINE AS FOUND IN YELLOW BIRCH PLYWOOD. C. A. Farrow, D. H. Hamly and E. A. Smith. Ind. Eng. Chem. Anal. Ed. *18*, 307–10 (May 1946). A new technique for the analysis of phenolic resin glue lines is described. The method involves complete removal of the veneers by digestion with chromic acid, the glue being left in an unaltered state suitable for microscopic examination and subsequent stereophotomicrography. This technique permits the rapid analysis of glue line structure without resorting to the laborious and time consuming methods of section analysis. It avoids damage to brittle glue line structures which cannot be sectioned even when the best methods of softening are employed. To obtain a good bond the resin must penetrate below the surface, which is usually damaged by the cutting tool. Observations indicate that adhesion cannot be attributed to either the specific or the mechanical theory but is dependent on the combination of the two.

A CONVENIENT SMALL OSMOMETER. B. H. Zimm and I. Myerson. J. Am. Chem. Soc. *68*, 911–12 (May 1946). A new small osmometer is described. It was designed for use with solutions of organic high polymers.

A PHOTOELECTRIC INSTRUMENT FOR LIGHT SCATTERING MEASUREMENTS AND A DIFFERENTIAL REFRACTOMETER. P. P. Debye. J. Applied Phys. *17*, 392–8 (May 1946). The method of determining particle sizes and molecular weights by light scattering measurements on solutions is finding increasing fields of application. In order to obtain the necessary data quickly and conveniently an instrument was developed which allows the required light scattering measurements to be taken on a routine basis. This apparatus is described. It measures transmission and scattering of light at 90°; two different schemes can be employed to obtain the angular intensity distribution of the scattered light. A description is also given of a compensating refractometer which is used to determine the difference in refractive index of solvent and solution. The instrument, which is simple in design, gives a direct reading of the refractive index difference and has an accuracy of better than 10^{-4}. The light scattering instrument was tested using polystyrene of known molecular weight, and was applied to study the change of apparent molecular weight (or particle size) of a series of polyvinyl ethers as a function of concentration in a number of solvents. For a series of polyvinyl *n*-butyl ether samples, the relation between the intrinsic viscosity (η_i) of the benzene solutions and the average molecular weight M determined by light scattering is $\eta_i = 0.365 \times 10^{-7} M^{1.48}$.

POLAROGRAPHIC DETERMINATION OF LEAD IN POLYVINYL CHLORIDE. G. Haim, F. Hirschler and B. D. Tarrant. Plastics (London) *10*, 318–21 (June 1946). A sample of the polyvinyl chloride plastic is fused with sodium peroxide; the melt is dissolved in water and acidified with nitric acid. The lead in the solution is then determined with a polarograph. The plastic can also be fused with sodium carbonate and potassium nitrate, but the peroxide method gives better results.

DETERMINATION OF FORMALDEHYDE IN HARDENED CASEIN. H. Nitschmann and H. Lauener. Helv. Chim. Acta. *29*, 174–9 (1946); Chem. Abstracts *40*, 2687 (May 10, 1946). The determination of formaldehyde in hardened casein is quantitative only if the formaldehyde is removed at low hydrogen ion concentrations such as that obtained with 0.1 M orthophosphoric acid.

ELASTIC DEFORMATION AND MOLECULAR WEIGHT IN POLYISOBUTYLENE. J. Rehner, Jr. J. Polymer Sci. *1*, 225–8 (May 1946). A rapid procedure is given for estimating average molecular weights of polyisobutylenes from deformation-rate measurements.

SOME PITFALLS IN ACCELERATED TESTING. R. E. Thomas. Am. Dyestuff Rep. *35*, 280–2 (June 3, 1946). Some pitfalls in interpreting the results of accelerated tests on plastic coated fabrics are discussed. The tests discussed include accelerated weathering, resistance to flexing and upholstery wear.

USE AND MISUSE OF ACCELERATED AGING TESTS. J. M. Buist and G. N. Welding. Trans. Inst. Rubber Ind. *21*, 49–66 (1945). The effects of the various test methods used to determine the resistance to natural and accelerated aging of rubber are discussed. The types of deterioration are described and testing recommendations are made.

THEORY AND APPLICATION OF THE PARALLEL PLATE PLASTOMETER. G. J. Dienes and H. F. Klemm. J. Applied Phys. *17*, 458–71 (June 1946). A method is established for the measurement of the viscosity of high polymers at low rates of shear in the range 10^4 to 10^9 poises using a parallel plate plastometer. This is based on a mathematical criterion for separating the viscous portion of the deformation from the *elastic* and *delayed elastic* components. Experimentally, the plate separation is measured at a given temperature as a function of time. The theory furnishes a relation, which is also the criterion for predominantly viscous deformation, between viscosity, plate separation, applied load and time. This relation, a modified form of Stefan's equation, is used for calculating the viscosity from the experimentally observed quantities. The method is applied to polyethylene and vinyl chloride-acetate resin compounds. The viscosity-temperature behavior of these materials is shown to be simple over the temperature range studied; that is, log viscosity varies linearly with the reciprocal of the absolute temperature. Data are presented which show that polyethylene resins and polyethylene resin-paraffin wax mixtures follow Flory's relation; that is, log viscosity varies linearly with the square root of the weight average molecular weight. Accordingly, the parallel plate plastometer offers promising possibilities for the empirical determination of the weight average molecular weight of these materials. Data are also presented on plasticized vinyl chloride-acetate resin systems which point to a close parallel between the effects of increasing temperature and increasing plasticizer concentration.

Synthetic rubber

TACKINESS OF GR-S AND OTHER ELASTOMERS. W. F. Nusse, J. M. Lambert and R. B. Verdery. J. Applied Phys. *17*, 376–85 (May 1946). The deficiency of GR-S in "tackiness" resulted in a great deal of work in the rubber industry to improve this complex property, but practically all the work had to be evaluated by qualitative hand tests because quantitative tests were not available. An analysis of the factors involved in the tackiness of various materials showed that different factors were critical in the so-called tackiness of rubber, paints and varnishes, printing inks, adhesive tapes, etc. A quantitative test was developed to measure the effects of rate of removal on the adhesion or tackiness of pressure-sensitive adhesive tapes over a 10^8-fold range of rates. This showed why the results of standard adhesion tests of

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tapes do not predict the relative behavior of the tapes under small forces acting for long times. Another test was developed for the measurement of the tackiness of GR-S rubber which correlates well with the judgment of tackiness by hand tests and it even works reasonably well with rough samples taken from a laboratory mill. With this test, the effects of mastication conditions, aging, and of the addition of softeners and tackifiers on tackiness of GR-S (with and without carbon black) were studied. The German tackifier Koresin, which is now manufactured in this country, was found to be far more effective than rosin and similar materials formerly used, and gave a tackiness approaching that of natural rubber.

VULCANIZATION REACTIONS IN BUTYL RUBBER. J. Rehner, Jr., and P. J. Flory. Ind. Eng. Chem. *38*, 500–6 (May 1946). Experiments were carried out to determine the chemical reactions that occur when Butyl rubber is vulcanized by quinone dioxime or related compounds. Observations were made of the reactions of these substances with simple olefins, and of the effect of oxidizing agents on the dioxime-type of vulcanization of Butyl in solution. The theory is proposed that in the vulcanization of Butyl by quinone dioxime or its esters, in the presence of oxidizing agents, the active agent is *p*-dinitrosobenzene formed by oxidation of the dioxime. Chemical reactions are suggested for the subsequent cross-linking or vulcanizing steps, and the results of confirmatory experiments are presented. *p*-Dinitrosobenzene and other polynitroso compounds are active vulcanizing agents for Butyl, natural rubber, Buna S, Buna N and Neoprene, and do not require the addition of an oxidizing agent. It is suggested that vulcanization of natural rubber by polynitro compounds involves their reduction to corresponding nitroso compounds as the first step, and that the nitroso group adds to rubber to produce cross linkages.

APPLICATIONS OF INFRARED METHODS IN THE STRUCTURAL EXAMINATION OF SYNTHETIC RUBBER. J. E. Field, D. E. Woodford and S. D. Gehman. J. Applied Phys. *17*, 386–92 (May 1946). The physical properties of a synthetic polymer are associated with variations in molecular structure which are dependent on the conditions of the polymerizing reaction and the monomers used. In some cases, structural differences of significance for physical properties cannot be detected by infrared methods because the relative number of chemical linkages affected is too small. An important structural detail which can be followed by infrared analysis is the relative amount of 1,2 and 1,4 polymerization occurring in polymerization reactions of butadiene. Absorption curves are reproduced to show the wide range in the relative amounts of these two structures. A description is given of an attempt to obtain a quantitative measurement of this ratio by means of a calibration curve derived from known mixtures of pure octene-1 and octene-2. For polyisoprene, variations in the proportions of 1,4 and 1,2 or 3,4 structure also occur depending upon the type of polymerization. Comparison with Hevea rubber and Balata fails to disclose definite evidence of trans-isomerism in synthetic polyisoprene. Structural differences due to oxidation of polymers may be readily apparent in infrared spectra, hydroxyl and carbonyl groups being especially prominent. The effectiveness of anti-oxidant in preventing structural changes caused by oxidation is shown in a series of absorption curves for samples of GR-S with and without anti-oxidant. When the samples were heat-treated in air, pronounced structural changes occurred for the sample without anti-oxidant, but no perceptible changes were evident for the sample with anti-oxidant. On the other hand, the anti-oxidant used (phenyl-β-naphthylamine) was ineffective for stabilization of the structure toward the ultraviolet light.

ELECTROSTATIC AND TENSILE PROPERTIES OF RUBBER AND GR-S AT ELEVATED TEMPERATURES. R. S. Havenhill, H. C. O'Brien and J. J. Rankin. J. Applied Phys. *17*, 338–46 (May 1946). A new apparatus for measuring electrostatic contact potentials on various materials at elevated temperatures is described. In this method the electrostatic charge, acquired by rolling a steel ball down the surface of a rubber test specimen on a heated inclined plane, is measured when the ball drops into the cup of a suitable measuring device such as an electrostatic modulator. With this instrument the contact potentials of both rubber and GR-S were found to become highly negative at elevated temperatures. This apparent boiling off of electrons and resultant disruption of electrostatic attractive forces within the material is much greater for GR-S than for rubber and probably accounts for the much greater decrease in tensile of GR-S over rubber at elevated temperatures, and is further confirmation of the electrostatic contact potential theory of reinforcement. By the further application of this theory, suitably dispersed compounding materials, which are in effect highly positive at elevated temperatures, such as certain proteins, finely divided silica and sodium silicate, were found to increase substantially the hot tensile strengths of the GR-S compounds.

COPOLYMERS OF DIMETHYLSTYRENE VINYL FATTY ESTERS WITH BUTADIENE. P. O. Powers. Ind. Eng. Chem. *38*, 837–9 (Aug. 1946). A series of synthetic rubbers made by emulsion polymerization of butadiene and α,*p*-dimethylstyrene in various ratios were prepared. These rubbers are comparable to copolymers with styrene but are apparently superior in tensile strength, and more nearly resemble natural rubber in processing characteristics. Synthetic rubbers were also prepared from butadiene and vinyl esters of fatty acids from vegetable oils. These synthetics are somewhat softer than GR-S. Tricopolymers of butadiene, vinyl fatty acid esters and a monovinyl compound exhibit interesting properties. Most notable of these is improved resistance to cut growth.

DETERMINATION OF HYDROPEROXIDES IN RUBBER AND SYNTHETIC POLYMERS. H. A. Laitinen and J. S. Nelson. Ind. Eng. Chem., Anal. Ed. *18*, 422–5 (July 1946). The relative amounts of hydroperoxide in natural rubber or synthetic polymers can be determined by allowing the peroxide to react with ferrous iron in benzene-methanol solution, using *o*-phenanthroline as a color reagent for the excess ferrous iron. Method gives results reproducible to about 20 percent on a given rubber solution, but sampling difficulties may cause larger variations on solid samples. The procedure as written is sensitive to 10 or 20 p.p.m. of active oxygen, calculated on the solid polymer, and it can be easily made sensitive to 1 p.p.m. by increasing the sample size and compensating for its color. Evidence is presented to show that the results with any ferrous iron procedure are high and have only relative significance.

GERMAN SYNTHETIC MECHANICAL GOODS. India Rubber World *112*, 723–7; *113*, 79–83, 231–5 (Sept., Oct., Nov. 1945). The properties and formulations of synthetic rubber compounds used by the Germans for mechanical goods are described in detail. The topics include synthetic rubber materials, compounding ingredients, textiles, belts, hose, molded goods, rubber covered rolls, tank linings, mixing procedures, tread stock and rubber to metal adhesion.

HEATING AND VULCANIZING RUBBER AND SIMILAR RESINS WITH HIGH FREQUENCY CURRENT. V. L. Smithers. India Rubber World *113*, 505–7, 566 (Jan. 1946). The results of some experiments on curing of rubber compounds by high frequency preheating are described. The advantages are 1) a substantial reduction in curing and molding time, 2) a product having uniformity of cure throughout and 3) a distinct improvement in the physical properties of the compounds.

HIGH FREQUENCY HEATING IN THE RUBBER AND ALLIED INDUSTRIES. G. P. Bosomworth. Rubber Age *59*, 429–40 (July 1946). The principles of high frequency heating are reviewed. Applications of this heating method in the rubber industry are discussed in detail. Twenty-two references are given.

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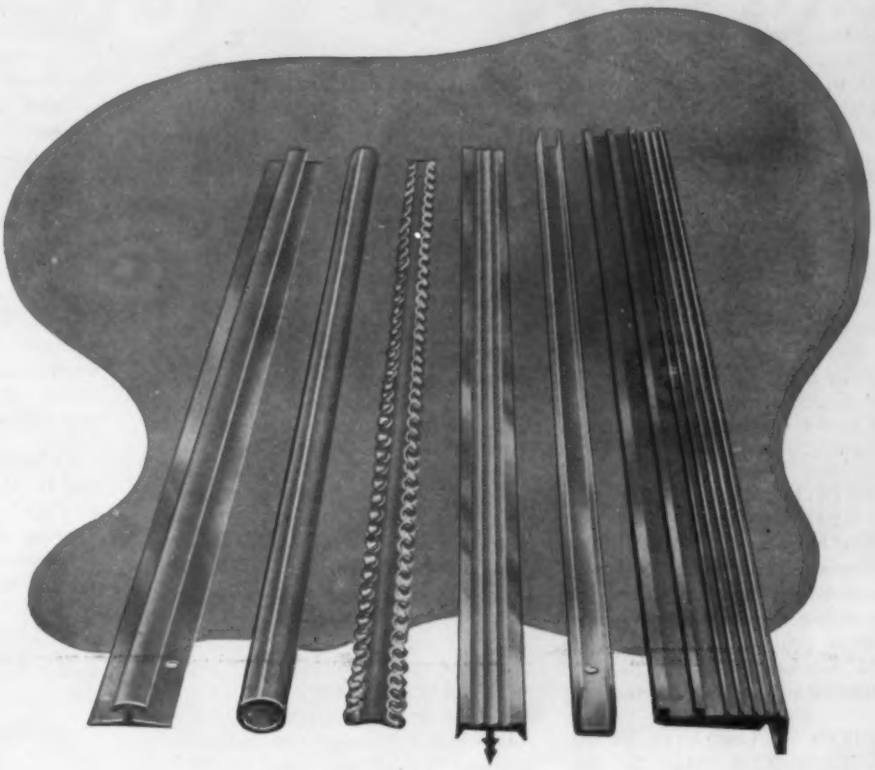

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RESIN. F. J. W. Popham (to British Rubber Producers Research Assoc.). U. S. 2,401,102, May 28. Synthetic benzene-insoluble resins are prepared from phenol, formaldehyde and oxidized rubber by intimately mixing and dissolving oxidized rubber in a mixture of phenol and formaldehyde in which there is an equimolecular proportion of formaldehyde to phenol, adding to the mixture a basic catalyst and heating the mixture to approximately 95° C. to precipitate resin.

PLASTIC WAX. O. M. Reiff and J. D. Zech (to Socony-Vacuum Oil Co., Inc.). U. S. 2,401,104, May 28. A plastic body is formed by heating chlorinated paraffin wax with an oxyaromatic material such as phenol, a naphthol or diphenyl ether in the presence of a Friedel-Crafts catalyst and thereafter dechlorinating by means of heating with dilute aqueous caustic.

CHLORINATED RUBBER. F. J. Bouchard (to Hercules Powder Co.). U. S. 2,401,133, May 28. Chlorinated rubber characterized by permanent flexibility in an unplasticized film is prepared by digesting rubber with a dilute aqueous solution of an acid at a temperature of 150 to 235° C., washing, drying, dissolving in a suitable solvent and chlorinating.

ABRASIVES. L. Coes, Jr. (to Norton Co.). U. S. 2,401,138, May 28. An abrasive article comprising abrasive particles bonded by the reaction product of an aminated phenolic resin and a resin-hardening, resin-solvent agent which is a halide able to react with resin polymer.

MOLDING. W. H. Parmelee (to Wheeling Stamping Co.). U. S. 2,401,180. May 28. Thin but rigid cap-like molded plastic articles are prepared by forming a blank of reinforcing flat-fibrous sheet impregnated with a resinous material, applying an adhesive material to the blank, applying resinous molding powder to the adhesive, and shaping and molding the composite sheet by forcing the central portion of the blank out of its original horizontal plane to form a cup-shaped article.

CHLORINATED RUBBER. E. J. Schlenk (to Hercules Powder Co.) U. S. 2,401,194, May 28. Chlorinated rubber having high unplasticized film strength is prepared by digesting rubber with water at 180 to 235° C., washing, drying, dissolving in a suitable solvent and then finally chlorinating.

MOLDING. F. J. Fielitz (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,401,236, May 28. An apparatus for forming uniformly sized pellets of plastic material for molding.

CELLULOSE ACETATE. J. L. Quinn (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,401,272, May 28. A composition comprising cellulose acetate plasticized with dimethyl azelate.

RACKET STRING. A. F. Smith (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,401,291, May 28. An athletic racket string comprising a corded structure having a smooth coating of an interpolyamide prepared from hexamethylenediamine adipate, hexamethylenediammonium sebacate and caprolactam, said corded structure comprising a plurality of twisted strands of polyhexamethylene adipamide.

PRESS. R. E. Glavin (to Universal Moulded Products Corp.). U. S. 2,401,299, June 4. An apparatus for molding and gluing comprising an open-ended container, a flexible impermeable membrane extending lengthwise within said container and secured at the edges thereof, thereby forming two chambers within the container, fluid pressure and vacuum connections, respectively, through the container wall to the upper chamber, a hollow mandrel in the lower chamber, a flexible bag located within the mandrel and fluid pressure connections thereto.

CELLULOSE DERIVATIVES. J. E. Jones (to British Celanese Ltd.). U. S. 2,401,304, June 4. Organic acid esters of cellulose are prepared by esterifying cellulose with an organic acid anhydride in a liquid medium which is a solvent for the primary ester formed, ripening the primary ester while in solution in an acidic ripening medium comprising water and a phenolic hydroxy compound.

PLASTICS. L. J. A. Lavallee. U. S. 2,401,306, June 4. Plastic name plates and the like are prepared by masking an area with a masking material which is soluble in a cleaning agent, coloring the name plate and removing the mask.

MOLDING COMPOSITION. E. A. Hauser and E. M. Dannenberg (to Research Corp.). U. S. 2,401,348, June 4. A molding composition comprising the finely divided ion exchange compound of a base exchange finely divided solid and an ionizable salt of a polymerizable olefinic carboxylic acid, said compound containing the polymerizable olefinic group of the above mentioned salt.

CELLULOSE DERIVATIVES. C. A. Thomas and G. Kosolapoff (to Monsanto Chemical Co.). U. S. 2,401,440, June 4. Cellulose is made fire-resistant by reacting with phosphoryl chloride to form a cellulose phosphoryl chloride and treating with ammonia to produce the corresponding phosphonamide.

POLYVINYL ACETATE. J. O. White (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,401,445, June 4. Vinyl acetate is polymerized by heating under agitation a mixture of vinyl acetate monomer, water, a peroxide catalyst, a water-soluble alkaline substance to maintain a pH between 4.9 and 3.8, and a starch dispersing agent.

TANNING AGENT. E. A. Robinson and R. M. Beach (to National Oil Products Co.). U. S. 2,401,508, June 4. Tanning agents are prepared by reacting a water-soluble dichromate with a lignin sulfonic acid-formaldehyde condensation product.

ARCH SUPPORT. W. M. Scholl. U. S. 2,401,514, June 4. An arch support composed of a thermoplastic resin.

COATING DEVICE. H. A. Cook, Jr. (to Auburn Button Works, Inc.). U. S. 2,401,550–1, June 4. A device and method for the application of plastic coatings to flexible strips.

WINDOW CONSTRUCTION. S. F. Cox (to Pittsburgh Plate Glass Co.) U. S. 2,401,552, June 4. A double-glazed unit comprising two laminated panels disposed in parallel spaced relation, one overlaying the other, each including outer plates of glass and a central sheet of tough, resilient plastic, layers of softer deformable plastic bonded upon opposite sides of each central sheet to form a laminated interlayer, the combined sheet and layers of plastic extending from one panel as a laminated mounting flange beyond the edges of the glass around the entire perimeter thereof and a plastic bridge integrally connecting the interlayers of the two panels.

THERMOPLASTIC WARE. V. E. Hofmann (to Owens-Illinois Glass Co.). U. S. 2,401,564, June 4. Apparatus to make hollow ware of thermoplastic material.

RESINS. I. E. Muskat and F. Strain (to Pittsburgh Plate Glass Co.). U. S.

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PIONEER PLASTIC MOLDERS . . . Established 1891

2,401,581, June 4. Resinous material comprising polymers of unsaturated esters.

EXTRUSION. J. R. Hiltner and W. Berlinghof, Jr. (to Rohm and Haas Co.). U. S. 2,401,642, June 4. Bubble-free shapes of substantial cross-sectional dimensions are produced from extrudable thermoplastic material by extruding under heat and pressure through a die into a pressure chamber containing a fluid under superatmospheric pressure, keeping pressure while cooling extruded object.

POLYMERS. A. D. Green (to Standard Oil Development Co.). U. S. 2,401,754, June 11. Polymers are prepared by discharging the slurry containing solid isoölefin products of the polymerization reaction at temperatures below −40° C. into a heated liquid medium to flash off the bulk of the low-boiling liquids, forming a slurry of polymer in the heated medium, stripping the slurry of low-boiling liquids, separating the polymer, passing through dryer, compressing the polymer.

MOLD. A. H. Heyroth (to Carborundum Co.). U. S. 2,401,760, June 11. Molds or mold parts are prepared for casting fluid material therein by reacting in a container, having a cavity of a shape conforming to that of the desired mold, a mixture with an acid of furfural or furfuryl alcohol, and after mixture has substantially carbonized, removing mold.

CASING. F. H. Reichel and A. E. Craver (to Sylvania Industrial Corp.). U. S. 2,401,773, June 11. A casing for stuffed products comprised of a film-forming organic plastic material.

TUBING. F. H. Reichel (to Sylvania Industrial Corp.). U. S. 2,401,774, June 11. A film-forming hydrophilic organic plastic tubing is continuously expanded to a predetermined size prior to drying by placing in the wet gel state, expanding with an isolated constant volume of fluid, and supporting the expanded section on surface of liquid body while it is advanced.

RESINS. H. S. Rothrock (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,401,776, June 11. A resinous product which yields air-drying films comprising the reaction product obtained by heating at 50 to 125° C. in the presence of an acid catalyst and a polymerization inhibitor, reactants consisting of an acyclic polyhydric aliphatic alcohol containing not more than six hydroxyl groups, two separated by a chain of at least four carbon atoms, and unsaturated aldehyde.

CASINGS. F. H. Reichel (to Sylvania Corp.). U. S. 2,401,798, June 11. A process for forming and testing a casing for a stuffed encased product.

METHALLYL ALCOHOL. H. F. Pfann and E. L. Kropa (to American Cyanamid Co.). U. S. 2,401,959, June 11. Methallyl alcohol is polymerized by distilling over strong alkali, subjecting to pure oxygen between 85 and 185° C.

JOINING DEVICE. G. H. Walton, J. C. Quayle and P. Jones (to British Insulated Cables, Ltd.). U. S. 2,401,991, June 11. An apparatus for joining strips of thermoplastic insulating material by heating the overlapping ends thereof.

ELASTOMER. F. E. Cislak and W. H. Rieger (to Reilly Tar and Chemical Corp.). U. S. 2,402,020, June 11. The copolymer of 2-vinyl pyridine and butadiene-1,3 prepared in an aqueous solution of sodium oleate with a peroxide catalyst.

ADHESION IMPROVEMENT. J. Compton (to B. F. Goodrich Co.). U. S. 2,402,021, June 11. The preparation of a composite structure comprising fibers of a synthetic linear polyamide incorporated into a vulcanizable rubber material is facilitated and improved by immersing the fibrous structure in a solution of a synthetic linear polyamide, removing from the solution before the tenacity of the fibers has been reduced, immediately reimmersing in a liquid in which the solvent is soluble but the polyamide is insoluble, removing from liquid and drying fibrous structure before incorporation into rubber.

INTERLINING MATERIALS. R. M. Fischer (to American Cyanamid Co.). U. S. 2,402,032, June 11. A shrink-proof garment lining material comprising a layer of fabric which is pretreated by impregnation with an aqueous solution of curable water-soluble methylated methylol melamine resin in amounts such that the 2 to 20 percent of the melamine is impregnated therein in conjunction with 1 to 25 percent of a heat-curable water-insoluble mixture of a phthalic anhydride-polyhydric alcohol resin and an organic solvent-soluble urea-formaldehyde or melamine-formaldehyde resin, followed by heating the cloth to cure resins therein.

WOOD TUBING. P. R. Goldman and R. Alt (to Plymold Corp.). U. S. 2,402,038, June 11. Wood veneer tubing is prepared by spirally wrapping a continuous veneer strip into elongated closed straight tubular form and continuously advancing it along a work path, oppositely spirally wrapping a second strip about the first, applying a layer of polymerizable bonding agent between the two layers, advancing continuously, and applying heat and pressure at each individual wrap.

TUBING. P. R. Goldman (to Plymold Corp.). U. S. 2,402,039–40, June 11. Composite lamellar tubing comprising, in combination, a series of concentric inner, intermediate and outer strata of sheet material, all bonded together as a structural unit having rigidity both radially and axially, said structure being bonded by a polymerizable plastic bonding medium, at least one of said laminae comprising a thin metallic tubular element; lamellar tubing comprising a radially rigid core of length-grained tape-like wood veneer strip material spirally wound in edge-abutted relation and bonded into a unitary hollow tubular element and a core-surrounding axially rigid element consisting of a straight-on wrapping of veneer having its fiber direction paralleling the tube axis, the entire structure being bonded with a polymerizable synthetic resinous material.

THERMOSETTING VINYL RESINS. E. E. Novotny, G. K. Vogelsang, E. E. Novotny (to Durite Plastics, Inc.). U. S. 2,402,075, June 11. Vinyl compositions such as polyvinyl acetals and polyvinyl alcohols are cured by admixing with aluminum stearate and then subjecting to curing temperatures between 275 to 310° F. for 30 to 45 minutes.

BUTTON. F. G. Purinton (to Patent Button Co.). U. S. 2,402,079, June 11. A button molded of plastic material.

ADHESIVE. L. M. Burgess and G. Abson (to H. P. Smith Paper Co.). U. S. 2,402,123, June 18. A thermoplastic, heat liquefiable, normally tacky adhesive composition comprising petrolatum, a terpene hydrocarbon condensation resin and an aluminum soap.

ZEIN. C. D. Evans (to A. E. Staley Manufacturing Co. and American Maize-Products Co.). U. S. 2,402,128, June 18. Modified zein is prepared by reacting in solution in a volatile solvent with an aldehyde at a temperature of 50° C. to form a solution which deposits a body which when dried at 130° C. for 3 hours is substantially non-blushing with water.

POLYMERS. W. E. Hanford and J. R. Roland (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,402,136–7, June 18. Polymers of ethylene and an N-vinyl derivative of a secondary amide are prepared by heating together in the presence of a per-oxy compound catalyst at a temperature of 50 to 250° C. under a pressure of greater than 5 atmospheres, the ethylene and amide being employed in a ratio no lower than 1:50, respectively, said N-vinyl derivative being N-vinyl secondary amide of a saturated aliphatic dicarboxylic acid or an aromatic dicarboxylic acid; a saturated aliphatic hydrocarbon radical substituted organic acid ester is prepared by heating under pressure above 200 atmospheres, organic acid ester free of olefinic unsaturation, peroxy catalyst.

FIBERS. C. C. Heritage (to Wood Conversion Co.). U. S. 2,402,160, June 18. Fibers of lignocellulose are prepared by heating lignocellulose in undefibered form in a gaseous environment containing water vapor at a temperature above 212° F. while rubbing it to its ultimate fibrils and simultaneously distributing into the material a heat-softened bituminous plastic material, such as a bitumen, a petroleum asphalt or a coal-tar pitch.

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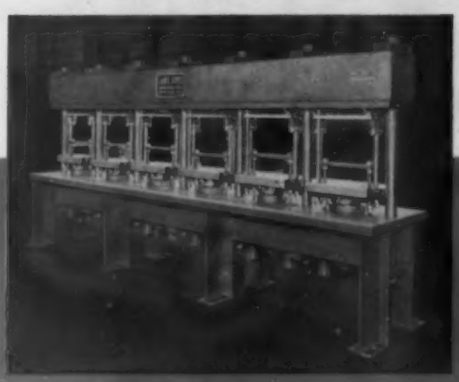

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3 Additional capacity may be provided through the introduction of multiples of the first mold with the advantages of more complete operation of the molds. In operation it is not uncommon to have one or two cavities in a large multiple cavity mold out of operation. It is not economical to remove such a mold too frequently nor is it permissible at all times to do so without excessive losses in production. Multiple units with fewer cavities in each permit more frequent mold repairs and replacements. Molds may be removed and replaced with others within a very short time.

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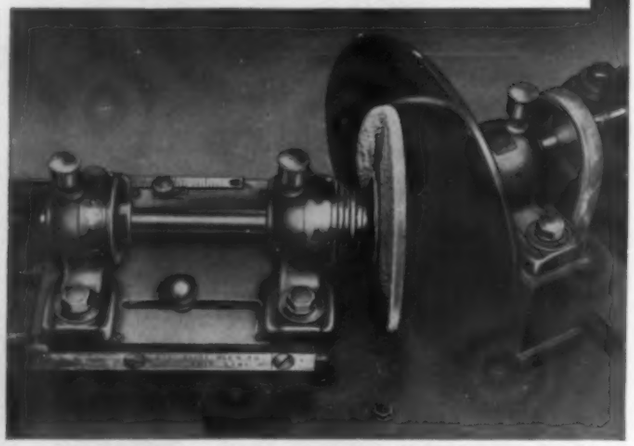

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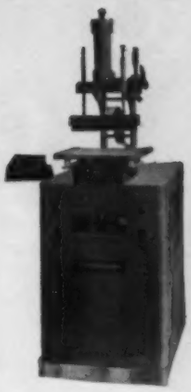

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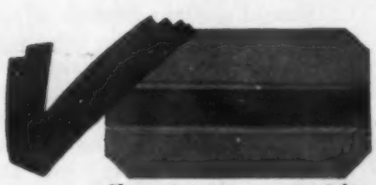

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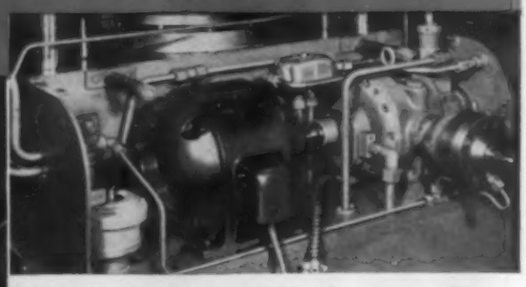
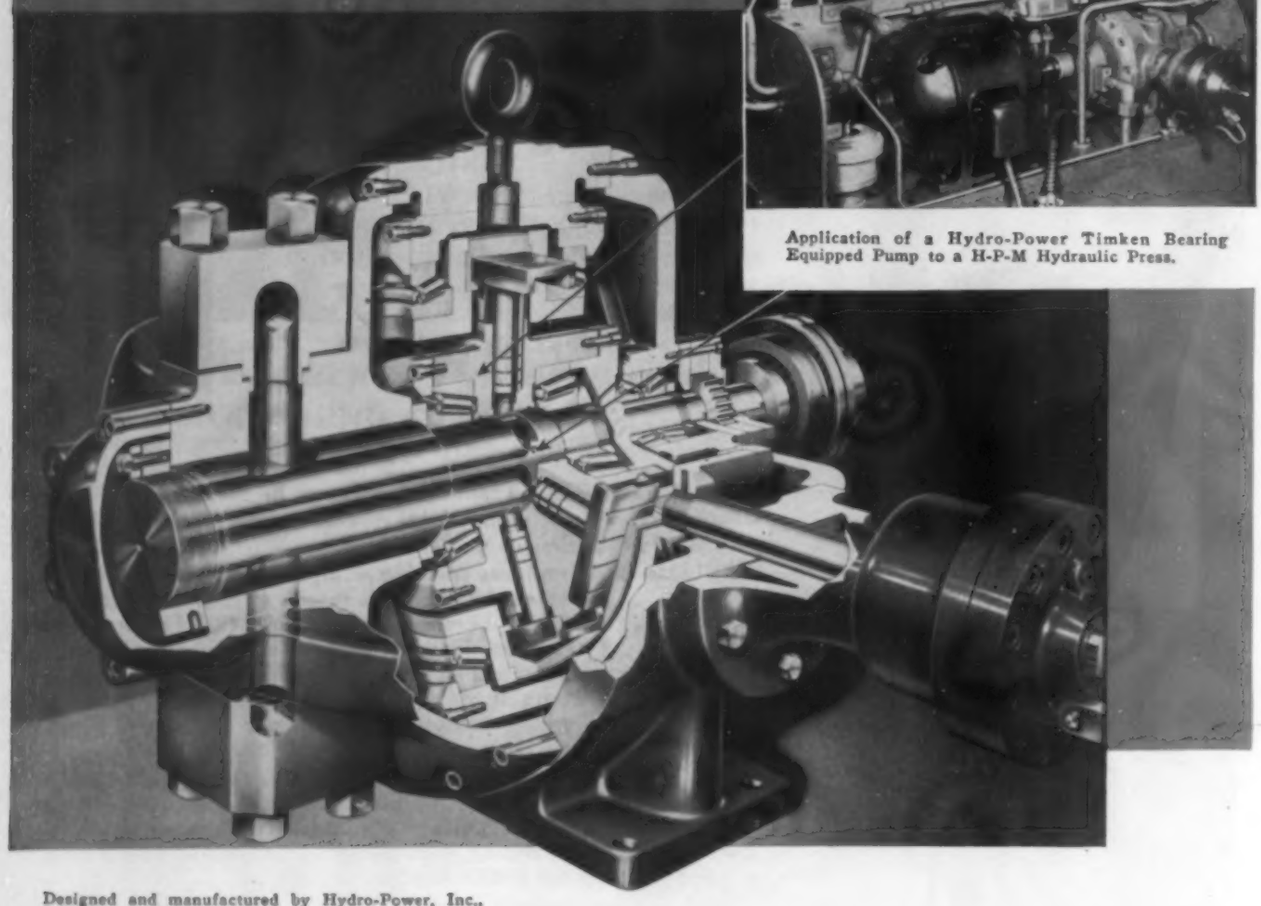


Application of a Hydro-Power Timken Bearing Equipped Pump to a H-P-M Hydraulic Press.



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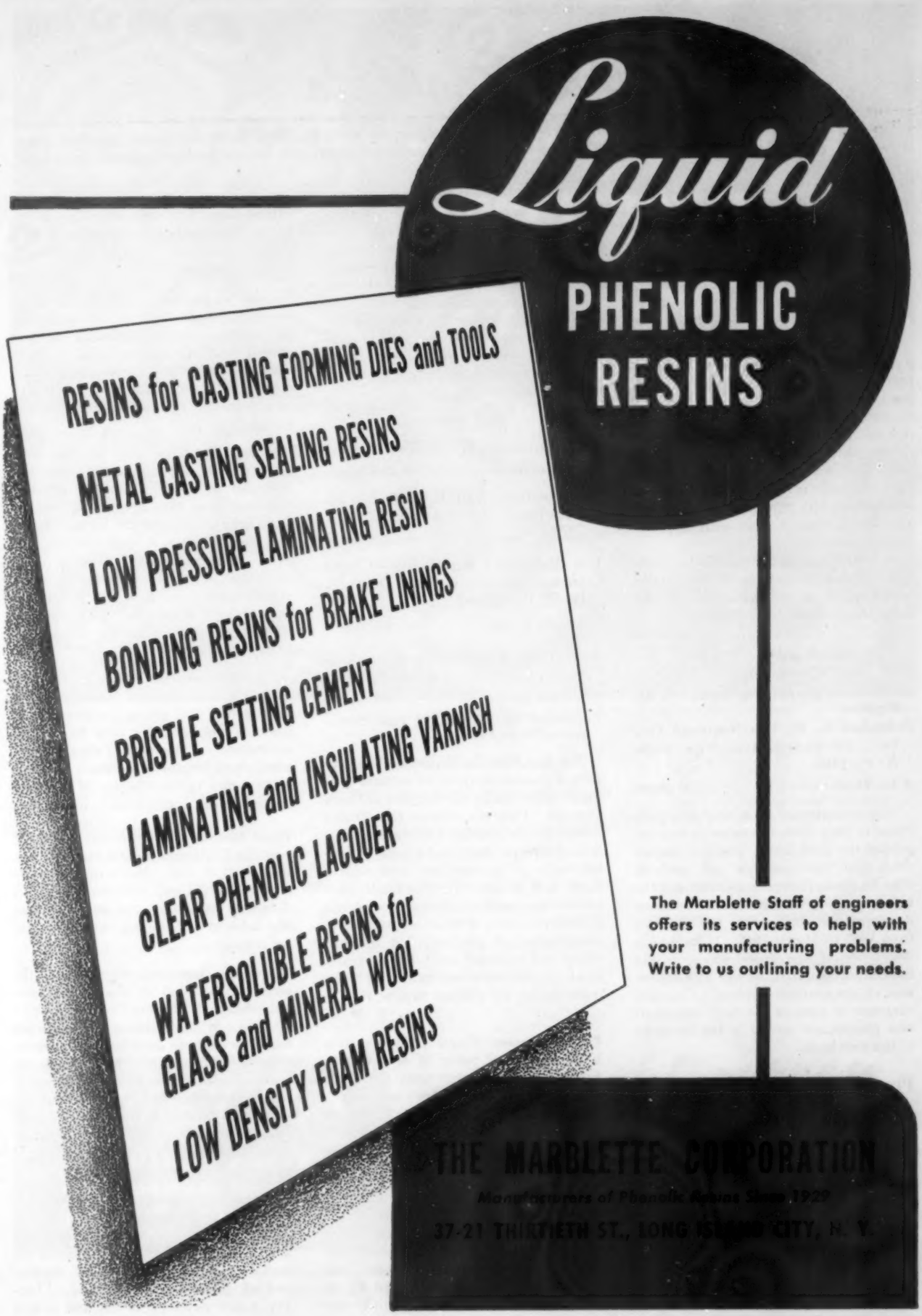
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Books and Booklets

Write directly to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery.

Experimental Stress Analysis, Vol. III, No. 2

Edited by C. Lipson and W. M. Murray

Published by Addison-Wesley Press, Inc., Kendall Square, Cambridge, 1945

Price $5.00 **166 pages**

These proceedings of the Society for Experimental Stress Analysis, which have been published semi-annually for the past three years, constitute a continuing record of technical advancement in this field. Among the techniques which were used in the investigations described in this latest issue are photoelastic stress analysis with plastic models, strain pattern determination with Stresscoat lacquer, and stress-strain measurement with electrical resistance wire gages.

This series should be available for study and reference purposes in all laboratories where engineers are concerned with the behavior of materials under load.

G.M.K.

The New Plastics

by Herbert R. Simonds and M. H. Bigelow

Published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York, N. Y., 1946

Price $4.50 **320 pages**

This authoritative book, originally published in May 1945, has recently been reprinted the third time. The first chapter deals with the materials and methods used by the industry up to 1940, and the balance of the book summarizes important developments throughout the industry from 1940 to March 1945. It includes a description of new fibers, adhesives and laminating materials, as well as a discussion of the synthetic rubbers. Chemical diagrams of some of the more important new plastics are carried in the appendix of this new book.

Physical Constants of Hydrocarbons. Vol. III. Mononuclear Aromatic Hydrocarbons

by Gustav Egloff

Reinhold Publishing Corp., 330 W. 42nd St., New York, 1946

Price $15.00 **661 pages**

This book marks the postwar resumption of publication of this series collating the available data on the melting points, boiling points, densities and refractive indices of mononuclear aromatic hydrocarbons. It is one of the American Chemical Society's monographs which are intended to give complete and critical treatment of relatively restricted areas and to stimulate further research in the specific field covered. The author has fulfilled these objectives in his critical compilation of data pertaining to an important group of hydrocarbons derived from coal tar and petroleum.

G.M.K.

Aminoplastes, by P. Talet(1946)

Price 280 francs **236 pages**

Les Resines Vinyliques, by H. Gibello

Price 260 francs **224 pages**

Les Produits Resineux— Gemmes, Colophane et Dérivés, by R. Lombard

Price 385 francs **288 pages**

Acétylène Homologues et Dérivés, by Pierre Piganiol (1945)

Price 490 francs **408 pages**

Published by Dunod, 92 Rue Bonaparte, Paris, France

The first three books listed above are part of a series on synthetic materials being published under the direction of Pierre Piganiol. They are evidence that France recognizes the growing importance of the field of high polymers and expects to contribute to its development, both scientifically and industrially. The fourth book reviews the chemistry of acetylene and its derivatives, many of which are used in the manufacture of plastics. The authors, editor and publisher are to be congratulated on this early culmination of plans made during the difficult days of 1944.

G. M. K.

Punch presses—Punch press operation is the subject of Series M of Industrial Safety Charts, received from the U. S. Department of Labor. Do's and don't's of safe practice are graphically illustrated in the charts which may be obtained for 5 cents from the Superintendent of Documents, U. S. Govt. Printing Office, Washington 25, D. C.

Trade facts—The 1946 edition of the "Market guide for Latin America" listing wholesalers, manufacturers, retailers, distributors, agents, etc., and pertinent trade information, has been announced by its publisher, American Foreign Credit Underwriters Corp., 170 Broadway, New York, N. Y. The guide is available on a subscription basis with monthly supplements and auxiliary services.

Source Material—U. S. Dept. of Commerce has prepared a list of sources of facts on plastics materials including governmental and non-governmental publications, directories and trade papers which may be obtained from the Inquiry Reference Section, Dept. of Commerce, Washington 25, D. C.

Armids—Blends of ethyl cellulose with paraffin and microcrystalline waxes are discussed in a new technical bulletin, "The armids as mutual solvents for waxes and plastics," brought out by the Chemical Div., Armour & Co., Chicago, Ill. Phase diagrams showing areas of compatibility are given. Resultant compounds vary from soft, wax-like materials to hard, flinty plastic-like surfaces. These are of course dependent upon the formulations chosen.

Air cylinders—The Hanna Engineering Works, Chicago 22, Ill., recently issued catalog No. 234, giving complete specifications and operating data for Hanna air cylinders. This catalog should prove particularly helpful to engineers and production men in the selection of cylinders for their many applications in industry.

Plant history—In the recent "Report" from the Cincinnati Milling Machine Co., Cincinnati 9, Ohio, the articles include a history of the mill, research findings on slide-way lubrication, and an elementary discussion of basic milling cutter sharpening principles.

Materials handling—Newest in the series of illustrated lift truck job studies published by Towmotor Corp., Cleveland 10, Ohio, is one covering the materials handling methods used by the Cleveland Graphite Bronze Co. These studies report in detail the methods used by many leading manufacturers to speed up the materials handling system with corresponding increases in efficiency and labor-saving economy.

Molded plywood—The Casein Co. of America, New York 17, N. Y., which is a division of the Borden Company, has published a 34-page booklet describing a new low-pressure laminating technique for the manufacture of flat, curved and complex molded resin bonded plywood. "Lap-Ply, a new technique in flat and molded

Molded by Molded Insulation Company, Philadelphia, Pa., from Celanese Plastic Corporation's "Celcon" ethyl cellulose.

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This cellulosic thermoplastic now brings to manufacturers of radio and other cabinets all of the valuable properties which once restricted ethyl cellulose to Army and Navy use. For example, remarkable toughness and impact resistance, dimensional stability, moldability, excellent electrical properties, extreme light weight.

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plywood manufacture" contains 29 diagrams and photographs illustrating and supplementing the text which is given over largely to a discussion of the structure, physical characteristics and manufacturing techniques of orthodox plywood as contrasted with Lap-Ply.

Molds—A leaflet, entitled "Mechanite—the metal for permanent molds," has just been prepared by the Mechanite Metal Corp., New Rochelle, N. Y. The leaflet describes and illustrates permanent molds used in the production of plastics, metals, glass and rubber.

Utensils and insulation—The Office of Technical Services, Department of Commerce, Washington, 25, D. C., has released a report, No. PB-21849, which contains the results of tests on plastic kitchen utensils. There is also a 112-page report on Iporka, an insulating material made from urea formaldehyde foam, developed by German industry. Both reports may be obtained for a dollar from the Office of Technical Services.

Recorders—The Bristol Co., Waterbury 91, Conn., has announced a new bulletin, No. S1400, describing its line of tachometer recorders and indicators. Complete wiring diagrams, application data and accessory information are given.

Diamond holder—The Booth 3-angle automatic self-leveling turret diamond holder is introduced in a bulletin issued by the Diamond Tool Co., Chicago 15, Ill. This accessory is designed to double the life of the diamond, lessen the consumption of wheels, improve the accuracy of the grind, and avoid destruction of diamonds by "out of round" wheels.

Price listing—The Heyden Chemical Corp., New York 1, N. Y., has recently brought out a price list covering its line of chemical products.

Operating equipment—Designed to be of genuine help to the processor in all fields is a new bulletin, "Buying guide of Allis-Chalmers equipment for the process industries," recently released by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

The company has also issued a booklet, designed for student training, which explains in detail its turbo-blowers, rotary compressors and vacuum pumps.

Dust collectors—American Foundry Equipment Co., Mishawaka, Ind., has issued a pamphlet on "Dustube" dust collectors. Included is an explanation of the cleaning and installation of this dust-collecting equipment.

Plasticizer—Monsanto Chemical Co., St. Louis 4, Mo., has released Technical Bulletin O-D-110 describing Santicizer 160, a new plasticizer still in the developmental stage which is designed especially for use in polyvinyl chloride, polyvinyl chloride-acetate, polyvinyl butyral resins.

Plywood—The best methods of sawing, gluing, nailing, painting, edge sealing and refinishing Kimpreg plastic surfaced plywood are explained in a pamphlet just published by the Plastics Div. of the Kimberly-Clark Corp., Neenah, Wis. A partial list of cold-setting resin glues and paints applicable for Kimpreg is given.

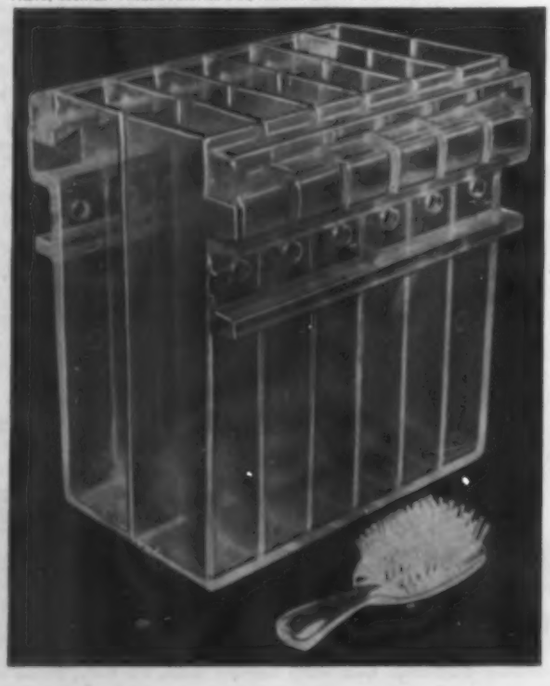
Machine tool—Denison Engineering Co., Columbus 16, Ohio, has introduced the Denison Multipress, a new bench-size hydraulic machine tool designed to produce a hydraulic "power package" for the small jobs of industry. Information on how this small, economical machine can be adapted to industry's specific needs is presented by the company in Bulletin 120.

Time switch—Automatic Temperature Control Co., Inc., Philadelphia 44, Pa., has announced, in Bulletin T-55, a new time switch to meet the needs of manufacturers of machines and process equipment where the supply runs into considerable volume and emphasis must be placed on a low-cost unit.

Filters—Just prepared by Drico Industrial Corp., New York 6, N. Y., is a booklet describing filters for gases and liquids. The varied uses of these filters in internal combustion engines and compressors, in the protection of electrical equipment from dust erosion, and in the chemical industries illustrate the rapid expansion of the field of mechanical separation.

Plastic coatings—All characteristics and properties of Amercoat plastic coatings are indicated in a technical comparison chart prepared by the Amercoat Div. of American Pipe and Construction Co., Los Angeles 54, California.

PHOTO, COURTESY PROLON PLASTICS DIV., PRO-PHY-LAC-TIC BRUSH CO.



A NINE LB. POLYSTYRENE BATTERY container which offers 20 percent reduction in weight, compared with aluminum and rubber, and was designed for the P-80 Jet-propelled Army plane, is being made by Prolon Plastics Div. of Pro-phy-lac-tic Brush Co. for the Electric Storage Battery Company.

Such extreme secrecy surrounded the development of the battery that the molders had only blueprints to work with and no details of use.

Plastic was chosen because certain design features could not have been incorporated if other materials had been used in battery. Lustron and Styron were adopted by Air Corps.

The assembled container measures 11 by 12 by $8\frac{1}{4}$ in. It is molded in two halves, each weighing about 5 lb., with the joint running vertically from end to end. The partitions are molded in and are not separate sections put in place after assembly. However, some holes are machined after molding. Special methods for precision machining, had to be worked out for this container.

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Add to these properties our range of five grades permitting any desired color intensity and you have a combination ideally suited to use in plastics.

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New Machinery and Equipment

Furnace for treating tools—To meet the need for a small capacity unit for precision treating of high-speed steel reamers, cutters, tools, etc., the K. H. Huppert

Co., Chicago 37, Ill., announces the Huppert "Hi-Temp" furnace. This furnace, available in floor and table models, is recommended for continuous operating temperature up to 2200° F., intermittent to 2250° F. It operates on 110 volt AC current only—consumption being 2 kw. Both models have inside dimensions of 5½ in. wide by 3½ in. high by 6 in. deep. The floor model is equipped with two steel shelves for temporary storage.

Cutter and tool grinder—The Cincinnati Milling Machine Co., Cincinnati 9, Ohio, has introduced a monoset cutter and tool grinder for conventional resharpening of end mills, reamers, counterbores, form cutters and for "problem" cutters, special sized drills, etc. Most jobs can be performed with a single chucking. The workhead may be swiveled through 235°. A two-speed drive for the grinding wheel spindle helps maintain correct cutting speeds with different sized grinding wheels. A high-speed spindle attachment for small mounted wheels provides a means for accurate internal grinding operations.

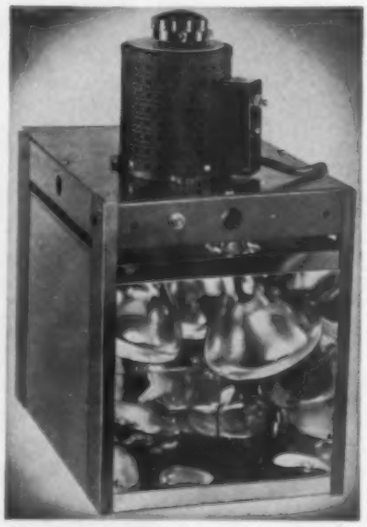
Preheater—The Delt Calesco Co., Far Hills, N. J., has announced a new two-drawer, open-side preheater incorporating the new infra-lectric industrial plate as a source of infrared heat. Adapted for preheating and dehydrating of plastics, the preheater is open on all sides to allow released moisture to be dissipated in the surrounding air. The drawers, which can be removed from either side, are 16 by 24 in. and consist of aluminum framework built about the plate for a depth of 2½ inches. This plate, which is a unit in itself, forms the bed of the drawer and plastic materials rest directly on it. Any degree of heat up to 380° F. can be maintained at the plate, with slight variation ±5° F. Standard plates measure 16 by 24 in. operating on 110 volts; 16 by 48 in. on 220 volts.

A variable speed lathe—A vari-speed lathe for speed and precision in grinding, deburring, sharpening, finishing and polishing as well as for hand milling with midget high-speed and carbide milling cutters has been announced by Precise Products Co., Racine, Wis. Power unit is the standard Precise 40 with maximum speed of 40,000 r.p.m. and power rating of ⅛ hp.

Turbo dryers—Turbo dryers VT-112L and VT-118L for experimental, pilot plant operation and for actual production where capacity requirements range between 1000 and 10,000 lb. per day have been announced by the Wyssmont Co., New York, 7, N. Y. They are suitable for handling slurries, sludges, pastes, crystals, chips, powders, grains, seeds. Dryer VT-112L is 6 ft. in diameter, 6 ft. high with 12 shelves while VT-118L is 6 ft. in diameter, 8 ft. high with 18 shelves. Continuous drying is obtained by repeated transfer and spreading of material during its travel from top to bottom. Fan system provides internal reheating, recirculation.

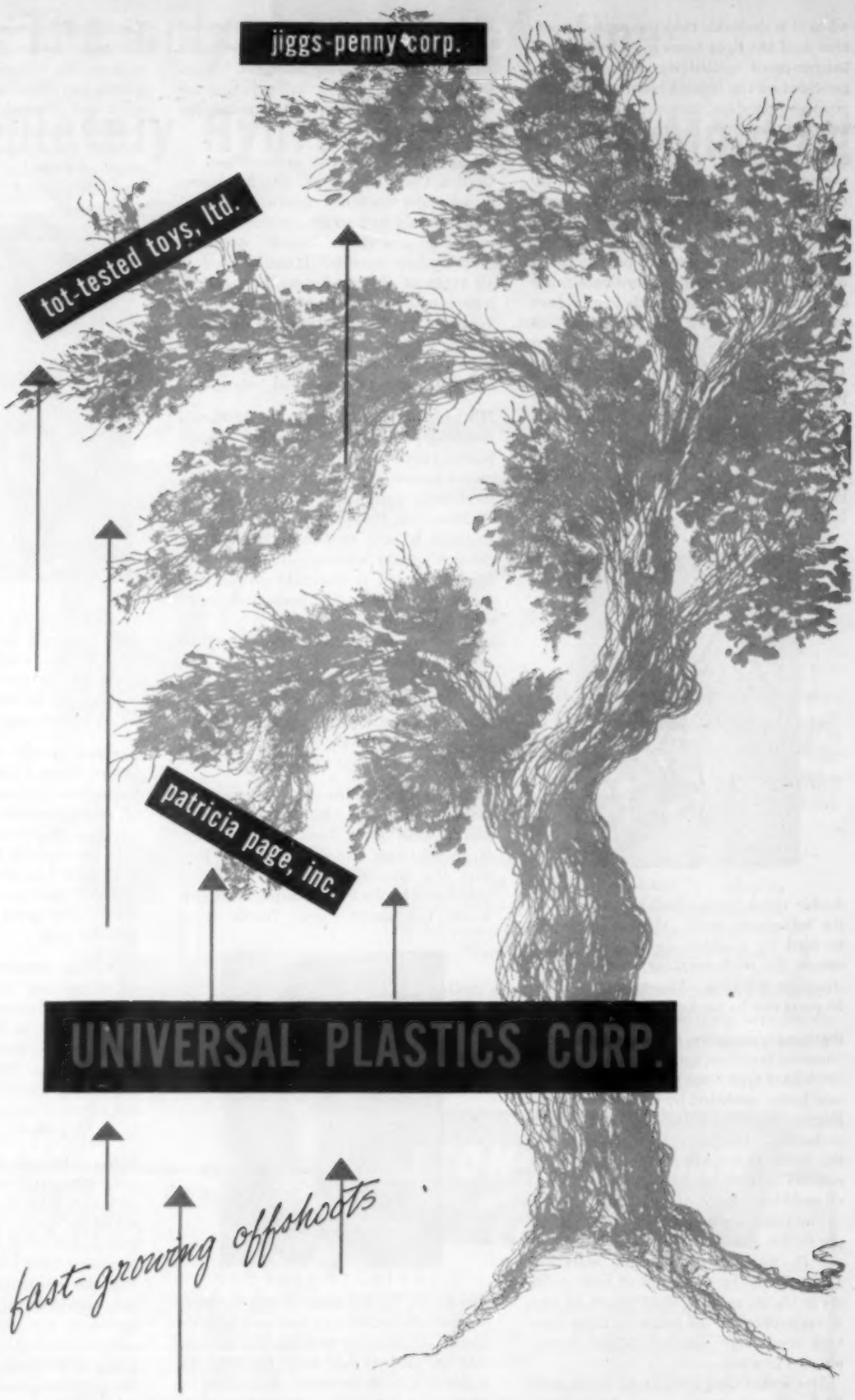
Hydraulic presses—Pomona Machine Works, Pomona, Calif., has announced two models of hydraulic presses for plastic and rubber molding in sizes up to 300 tons. The first model has a downward-acting ram, with the pull-back cylinder and ram located at the top of the press. The second, shown above, has an upward-acting ram with the pull-back cylinder located either at the bottom or at the top. Both are semi-automatic in operation and can be made to specifications. They are furnished with or without knockout cylinders, pumping units and accumulators.

Heating kit—A bench-kit built around a standard lamped panel is announced by Miskella Infra-Red Co., Cleveland 4, Ohio. In the bench-kit, the lamped panel is suspended horizontally above the insulated-reflective bottom tray, which not only serves to protect the bench from damage by heat but re-directs stray heat rays. These kits come in seven sizes ranging from 10¼ in. wide, 12 in. high, 8¼ in. long to 30¾ in. wide, 18 in. high and 27½ in. long. The smallest size has



two sockets; the largest 24. Kits may be stationary or portable and temperatures from 70 to 400° F. are obtainable.

Photoelectric units—Photoswitch series 20 and 21 controls, high-speed photoelectric units for general industrial and machinery application, have been introduced by Photoswitch, Inc., Cambridge 42, Mass. In case of current failure and when tube replacement is necessary, control series 20 operates as if the light beam were not broken. On the other hand, control series 21 is used as a machinery safeguard, for break-detection in the textile, paper and wire industries and for other application



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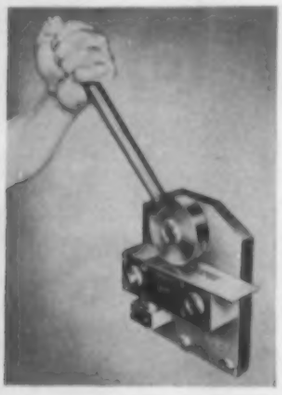
when it is desirable that the control operates as if the light beam were broken. A tamper-proof sensitivity adjustment is provided on the control housing to permit positive operation over varying distances between phototube and light source.

Microscope—For inspection and measurement of large tools, jogs, templates, machine parts, threads and similar items being held to close tolerances, the Gaertner Scientific Corp., Chicago 14, Ill., introduces a toolmaker microscope. It has a mechanical stage with a coordinate range of 8 by 4 in. combined with 360° rotary motion and is capable of supporting a load of several hundred pounds.

Marking machine—Four lines of a company name and address can be easily sunk into untempered steel, stainless steel or other sheet materials with the new Acromark No. 920 hand-operated bench type marking machine which has been introduced by the Acromark Co., Elizabeth, N. J. The flat part passes over a



double row precision ball bearing held in the adjustable arm. This machine can be used for marking scales used on machines, for trade-marking, name and instruction marking. Approximately 30 to 40 parts can be marked per minute.

Bushings, reamers, plugs and baffles—Shoulder bushings, sprue bushing reamers, hex socket type brass plugs and baffles are now being marketed by the Detroit Mold Engineering Co., Detroit 12, Mich. Of carburized, hardened and ground steel, the bushings are being used in all cavity retainer sets 12 by 12 and larger and in all mold bases larger than a No. 2.

The reamers come in two tapers, 1/2 in. per ft. for general purpose use and 3/4 in. per ft. for use with acrylic materials. Diameter of the small end of both reamers is 7/32 in. and the flute length of each is approximately 10 inches. Tests show best results are obtained when reamers are run in a lathe.

Hex socket type brass plugs which make flush assembly in the steam plate possible are also available. Standard 11/16 in. diameter brass baffles for steam plates are made with a 1/4 in. diameter hole running lengthwise for mounting on 1/4 in. round brass rods. These rods are available in any length. A countersunk hole, 3/32 in. in diameter, is drilled halfway through baffle to provide means of fastening the baffle to the rod.

Temperature control unit—Claud S. Gordon Co., Chicago 16, Ill., has introduced a new Xactline temperature control which is said to provide variation as low as 1/5° F. and power "on-off" cycles as short as three seconds. It can be used on all types of electric furnaces, ovens, injection molding machines employing conventional millivoltmeter and potentiometer type controlling pyrometers or gas fired equipment employing solenoid-controlled or motor-operated valves.

Hinged top record presses and 500-ton hobbing press—A 500-ton fully hydraulic hobbing press and two types of hinged top record presses, 75- and 110-ton capacities, have been introduced by the Watson-Stillman Co., Roselle, N. J. The 500-ton machine is said to handle heavy-duty, die-sinking and hobbing. It can be supplied with hand- or motor-driven pumps—the vertical triplex, the horizontal or the stedi-flow type.

Both record presses have operating pressure of 2000 p.s.i., a stroke of 2 1/2 inches. They are available for accumulator operation where an hydraulic power source is already installed or in self-contained models having motor, pump and oil reservoir built into base of machine.

A folding machine—A "Thermofold" plastic folding machine which can fold plastic sheeting of from 0.005 to 0.020 in. in thickness into a U type-180° fold, with the sides tight together has been announced by the Plastics Equipment Div. Taber Instrument Corp., North Tonawanda, N. Y. By using thermostatically controlled heat, the unit forms a fold in the plastic sheeting by molding the material into the desired fold and eliminates the faults of a crease or bend. It enables the average operator, the company says, to produce 700 formed folds an hour. The output may be increased when feasible by folding in multiples.

Jacket oil heaters—A new line of jacket oil heaters—low-pressure heat transfer systems for cylinder jackets and dies of plastic extruders, calender rolls, jackets of stills and processing kettles and similar jacketed equipment—has been introduced by the Youngstown Miller Co., a subsidiary of Walter Kidde & Co., Inc., Belleville, N. J. Four standard sizes

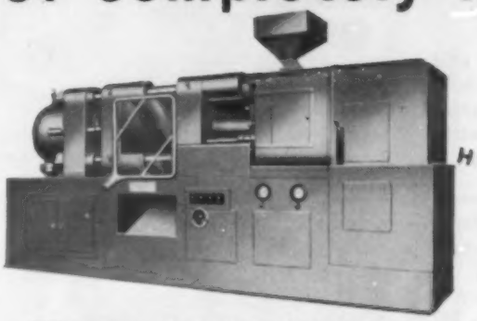
ranging from 14 to 63 kw. and special units to supply any volume of heat up to 550° F. are available. Units come as stationary or portable models. Heat is supplied by finned tube heaters through which heat transfer oil is pumped.

Instant speed changer—The Chicago Drillet Corp., Chicago 22, Ill., announces the instant speed changer, a quick method of obtaining correct drilling and tapping speeds on all drill presses without changing belts or stopping the motor. A standard drill press equipped with speed changer and standard four-step cone V-belt pulley will have a speed range from 435 r.p.m. to 4550 r.p.m.

Marking attachment—The Rolacoder 50, a marking attachment for placing a continuous impression on the bottom of a case or crate as it moves along a roller conveyor, has been marketed by Adolph Gottscho, Inc., New York 13, N. Y. It is installed in a conveyor in place of a standard roller. Two type sizes are available—3/8 or 5/8 inches.

Self-contained platen press—A 50-ton self-contained platen press suited to laboratory and general service has been introduced by the R. D. Wood Co., Philadelphia 5, Pa. This press can be operated at pressures from 1000 to 3000 p.s.i. by setting the automatic pressure controller at the required pressure. During curing period, in the event that pressure in the system should drop 2 to 2 1/4 percent, the pump is automatically started to rebuild the required pressure. The 15- by 15- by 2-in. platens are machined parallel within 0.003 inch. Pressure is supplied by a 3.8-g.p.m., 3000-p.s.i. capacity radial piston pump with a 5-hp., 1200-r.p.m. motor.

The only **complete** line of completely Hydraulic Plastic Molding Equipment



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HOBBING PRESSES 200 TON 3000 TON

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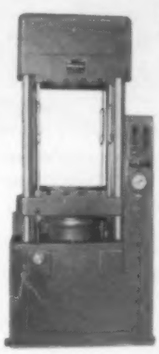

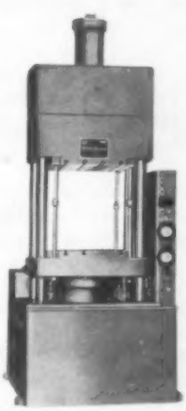

NO MATTER what process, or—what plastic material you want to use—Watson-Stillman can supply a machine to fit it. In the complete W-S line of hydraulic plastic molding equipment you will find the right equipment for your job and the process best suited to it.

Horizontal Injection—8 to 80-oz. capacities • Compression Molding—50 to 1200-ton capacities • Tableting Machine—100-ton capacity • Transfer Molding—50 to 1200-ton capacities • Vertical Injection—1 and 4-oz. capacities • Hobbing Presses—200 to 3000-ton capacities

Without obligation, ask for Watson-Stillman's advice on selecting equipment, or call W-S for help in solving any plastic molding problem. The Watson-Stillman Co., Roselle, N. J.

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MANUFACTURERS OF THE MOST COMPLETE LINE OF HYDRAULIC MACHINERY

News of the Industry

● A course in plastics for retailers is being offered jointly by the New York University School of Retailing and the Committee on Plastics Education of the Society of the Plastics Industry at the Washington Square Center of the University beginning Sept. 30. Lectures will be given by selected experts from both the plastics and retailing industries on 14 successive Monday evenings. Information on what various types of plastics will and will not do in use; how they should be cleaned, handled and otherwise cared for; how they will react to light, heat, water, acids, alkalies, etc.; and similar problems of importance to the consumer and retailer will be emphasized. Stores cooperating in the program include: Abraham & Straus, Inc.; Allied Purchasing Corp.; B. Altman & Co.; Bloomingdale Bros., Inc.; Bonwit Teller; Brooks Bros.; Arnold Constable & Co.; B. Gertz, Inc.; Gimbel Bros., Inc.; W. T. Grant Co.; Hahne & Co.; Hearn Department Stores, Inc.; Hecht Bros.; Interstate Department Stores, Inc.; Frederick Loeser & Co.; Lord & Taylor; James McCreery & Co.; R. H. Macy & Co., Inc.; The Namm Store; Oppenheim Collins & Co.; Ohrbach's Affiliated Stores, Inc.; J. C. Penny Co.; Russeks Fifth Avenue; Saks Thirty-Fourth Street; Saks Fifth Avenue; Franklin Simon & Co.; Stern Bros. and John Wanamaker.

Members of the Committee on Plastics Education of S.P.I. are Horton Spitzer, chairman, Plaskon Div., Libbey-Owens-Ford Glass Co., Toledo, Ohio; Clayton S. Shoemaker of Dow Chemical Co., Midland, Mich.; Charles A. Breskin, MODERN PLASTICS magazine; Dr. R. V. V. Nichols, Department of Chemistry, McGill University, Montreal, Canada; Frank H. Shaw, Shaw Insulator Co., Irvington, N. J., and E. A. Stillman, Watson-Stillman Co., Roselle, N. J.

● The Ontario Plastics Co., Rochester, N. Y., has been formed to take over the assets and continue operation of the Murlon Plastics Co., which has been dissolved. John F. Spitznagel, formerly of Auburn Button Co., is vice president and general manager and R. L. Hayes is president and treasurer. The company will specialize in injection molding.

● Twenty percent of the Dow Chemical Co.'s $101,813,839 worth of business for the year ending May 31, 1946, was in plastics, according to the company's annual statement. The wartime peak of total sales was $124,570,200 in 1944–45. A three- to four-year expansion program will cost $40,000,000. As to the future for plastics, President Willard H. Dow said he expected them to create new markets but doubted that they would displace older materials unless they provided better methods of accomplishing given results.

● A graduate course on pulp and paper technology, similar to the course offered last year, will be given at the Polytechnic Institute of Brooklyn, New York, N. Y., during the academic year 1946 to 1947.

●The merger of the Pantasote Co., of Passaic, N. J., and Textileather Corp., of Toledo, Ohio, into the new corporation, Pantasote Plastics, Inc., has been announced jointly by Hans Wyman and J. D. Lippmann, presidents of Pantasote and Textileather, respectively.

Officials of Pantasote Plastics are: Mr. Wyman as president; Mr. Lippmann and Henry W. Wyman of Pantasote Co., vice presidents; Rudolph Koppl of Pantasote Co., treasurer and Henry Cape, Jr., of Pantasote Co., secretary. The board will include all officers, excepting Mr. Cape. Other members will be L. H. Green of Detroit, chairman of Textileather and H. E. Collins of Toledo, director of Textileather, executive committee chairman.

● A cylinder for the injection molding of thermosetting material has been developed by the General Machine & Tool Co., Walled Lake, Michigan. Patents are now pending on this unit.

● Controlling interest in the Prince Industrial Plastics Co., Cleveland, Ohio, has been bought by the Van Dorn Iron Works Co. New officers are: N. T. Jones, president and general manager; L. C. Jones, assistant general manager, and J. L. Jones, vice-president and treasurer.

● J. C. Stokes and Harold H. George have formed the Perry Plastics Co., Erie, Pa., which will specialize in finishing and assembly operations.

● A standard production injection machine for testing styrene molding powders soon to be available to molders has been installed at the Koppers Co., Butadiene Div., Monaco, Pa.

● Announcement has been made of the formation of a new plastic company, the Sonette Plastics Co., Chicago, Ill., which will specialize in molded dispensers.

● Duorite Plastic Industries and Duorite Engineering Co., both of Culver City, Calif., have been merged into a new firm, the Calresin Corporation. Officers are: L. C. Wilson, president; William Lockwood, vice president and treasurer; Aatto Annala, vice president and secretary; and William Davis, vice president. The Calresin Corp. will also have a Los Angeles export office and representatives in San Francisco, Chicago and New York.

● Manufacturers' ceiling prices on plastic thermosetting laminates and on vulcanized fiber have been increased 12 and 8 percent, respectively, by a recent OPA order. Geon resins and plastics have been released from Government price control.

● The construction material of United States Plywood Corp., New York 18, N. Y., made by bonding a thin wood veneer to metal and known as Decorative Armorply, will hereafter be called Flexmetl, according to a recent announcement.

● The Lake Erie Engineering Corp., Buffalo 17, N. Y., has taken over the Feller Engineering Co., Pittsburgh, Pa., specialist in hydraulic extrusion presses and allied lines. K. Feller will serve as general manager of the new Feller Engineering Division.

● Announcement has been made of the organization of the Fairfield Co., New York 11, N. Y., for the manufacture of adult games and plastics.

● A complete service of industrial and product design, advertising art work and copywriting is offered by Phyllis Sloane and Newson Shewitz in their new organization known as PDA which has headquarters in Cleveland, Ohio.

● Prismlac, a new lacquer enamel which air dries to prism-like formations, has been announced by Maas & Waldstein Co. The coating is said to produce attractive crystallizations on glass and metals.

● Purchase of all issued and outstanding capital stock of Plastimold Corp., Attleboro, Mass., has been announced by the Emerson Radio & Phonograph Corp. Plastimold manufactures plastic cabinets for radios, other molded plastic products.

● Leaf Plastics, Inc., Yonkers, N. Y., has been organized for the custom molding of all thermoplastic materials. Officers are: George W. Leaf, president; Dr. William R. Leaf, secretary-treasurer, technical director; Saul Blitz, plant superintendent.

● Committee members for the plastics show to be held in conjunction with the Society of Plastic Engineers' convention in Chicago on Jan 28 to Feb. 2 are: W.

Skillful Molding

MEANS TUNEFUL PERFORMANCE

Cobra Tone Arm, molded for Zenith Radio Corp. Chicago

Yes, skillfully molded plastic parts do help the flow of beautiful melody in any music reproducing instrument. A striking example is this Cobra Tone Arm which we molded for the Zenith Radio Corporation. We were commissioned to mold a piece that would help to serve in bringing new vibrance and tonal color to phonograph record performance. From the careful selection of the *most suitable* plastic material through the precision molding, we had music on our minds. The amazing musical success of the Cobra Tone Arm proved we worked in the right key. We can work equally well in tune with your production aims. Let our engineers help you today.

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B. Hoey, executive secretary of the society, as show exhibits chairman; William L. Mess, Anesite Co., and Robert G. Chollar, National Cash Register, chairman and vice chairman of the meetings committee; Charles C. Henry, Chicago Die Mold Corp., chairman, speaker committee; Harry J. McGowan, Bakelite Corp., chairman, finance and budget committee; James A. Boyajian, Product Mfg. and Engineering Corp., and M. H. Froelich, Ziff-Davis Publishing Co., publicity chairman and vice chairman.

Other committee chairmen are: L. H. Amrine, president of Imperial Molded Products Corp., registration; Arthur Lovgren, Industrial Molded Products, Inc., reception; Forest Wilson, Barnes & Reinecke, Inc., decorations; Miss Mae Wirth, Imperial Molded Products Corp., and Jesse H. Day, Case School Applied Science, printing.

● Formation of Jacobus Plastics, Inc., Jacobus, Pa., has been announced by Ben L. Franklin and his two sons. The plant is set up for compression molding and is equipped to make molds and dies.

● A Technical Service Laboratory under direction of Dr. L. H. Cohan has been opened by the Witco Chemical Co., New York 17, N. Y. Dr. Cohan was formerly director of research for the Continental Carbon Co., a Witco subsidiary. The laboratory is equipped with modern facilities for studies in rubber, plastics, paint and general chemical work.

● The B.D.S. Industries, Inc., New Haven 1, Conn., has been organized and will offer pulverizing and grinding services to the rubber pigment and plastic trades. Officers and directors are: R. M. Blake, president and chairman of the board; J. H. Davidson, vice president, sales manager; G. F. Steele, secretary, treasurer.

● Colorite Plastics, Inc., Passaic, N. J., has purchased a part of the Mack Mfg. Co., plant at Allentown, Pa., for the production of molding materials.

● Construction is now underway on a research center for the B. F. Goodrich Co., Akron, Ohio, to be located in Brecksville, midway between Akron and Cleveland. The center will house a conference room, 81 laboratory units alterable in size and shape, and a technical library.

● The Harris Co., Urbana, Ill., which will engage in plastic fabrication and in the manufacture of plastic store and kitchen equipment and general plastic construction, has been formed by W. M. Harris.

● The Velveray Corp., New York 13, N. Y., announces the opening of a branch office in Los Angeles, Calif., under the management of Harold Harris.

● Barnes & Reinecke, Inc., Chicago 11, Ill., has announced the acquisition of the Shoberg Tool Co., Inc., producer of tools, dies and special machinery. The firm will operate as a Barnes & Reinecke subsidiary, with Fred Shoberg, founder, continuing as president.

WILLIAM H. MILTON, JR.

● William H. Milton, Jr., of Pittsfield, Mass., manager of General Electric Co.'s plastics divisions and assistant general manager of the chemical department, has been named administrator of the Hanford Engineer Works, atomic energy operation in southeastern Washington.

His assignment came simultaneously with the passage of civilian management from E. I. du Pont de Nemours & Co., Inc., to the General Electric Co. on September 1. Du Pont had conditioned its original agreement with the War Department on early release at the end of the war. The Army, for the present, will retain final authority over Hanford, as over all atom projects, including the release of atomic information. Army commanding officer there is Lt. Col. Frederick J. Clarke. General Electric is answerable to the Army for the administration of municipal government functions.

Mr. Milton's new position puts him between Hanford and General Electric's nuclear advisory board: Harry A. Winne, vice president in charge of engineering policies; Dr. Cay Jeffries, vice president and general manager of the Research Laboratory.

The company will devote itself to fundamental research, development and operational work at the $350,000,000 plutonium and uranium "factory" which occupies 600 square miles. There are seven manufacturing plants, six processing uranium and plutonium and one refining uranium ores. No change in policy is seen and less than 3 percent of du Pont's 5,000 Hanford employees are pulling out. According to company officials, however, there is a shortage of junior physicists, metallurgists, chemists, chemical engineers and nuclear scientists.

● Plans to install the first full-scale process for the continuous manufacture of precipitated pigment colors have been announced by the Pigments Dept., E. I. du Pont de Nemours & Co., Inc. Installation will be made at the pigment plant in Newark, N. J., and should be complete in five months. According to the company, the new process represents the first fundamental change in the manufacture of chrome pigment colors in years.

Announcement has also been made of a new pigment color, "Auric Brown," which is said to provide brighter, cleaner and more durable shades of brown colors for industrial enamels, trim paints, coated papers, textiles and possibly plastics.

● Elastomer No. 105, a new rubber-like plastic compound which can be cast, molded, extruded or applied by dip, spray, roll coating and other methods in any desired thickness in a single application, has been announced by the Electro-Technical Products, Inc., Nutley 10, N. J. It is said to have a high resistance to most solvents, including aromatic hydrocarbons, oils, acids, alkalies and water, and not to oxidize and harden on aging, to retain its flexibility at low temperatures and not to sustain a flame. The recommended curing temperature is 160° C. However, special compounds may be custom formulated to be cured at as low a temperature as 95° C. The curing time depends on the thickness of the finished product—approximately 5 min. per 1/8 in. is required at 160° C.

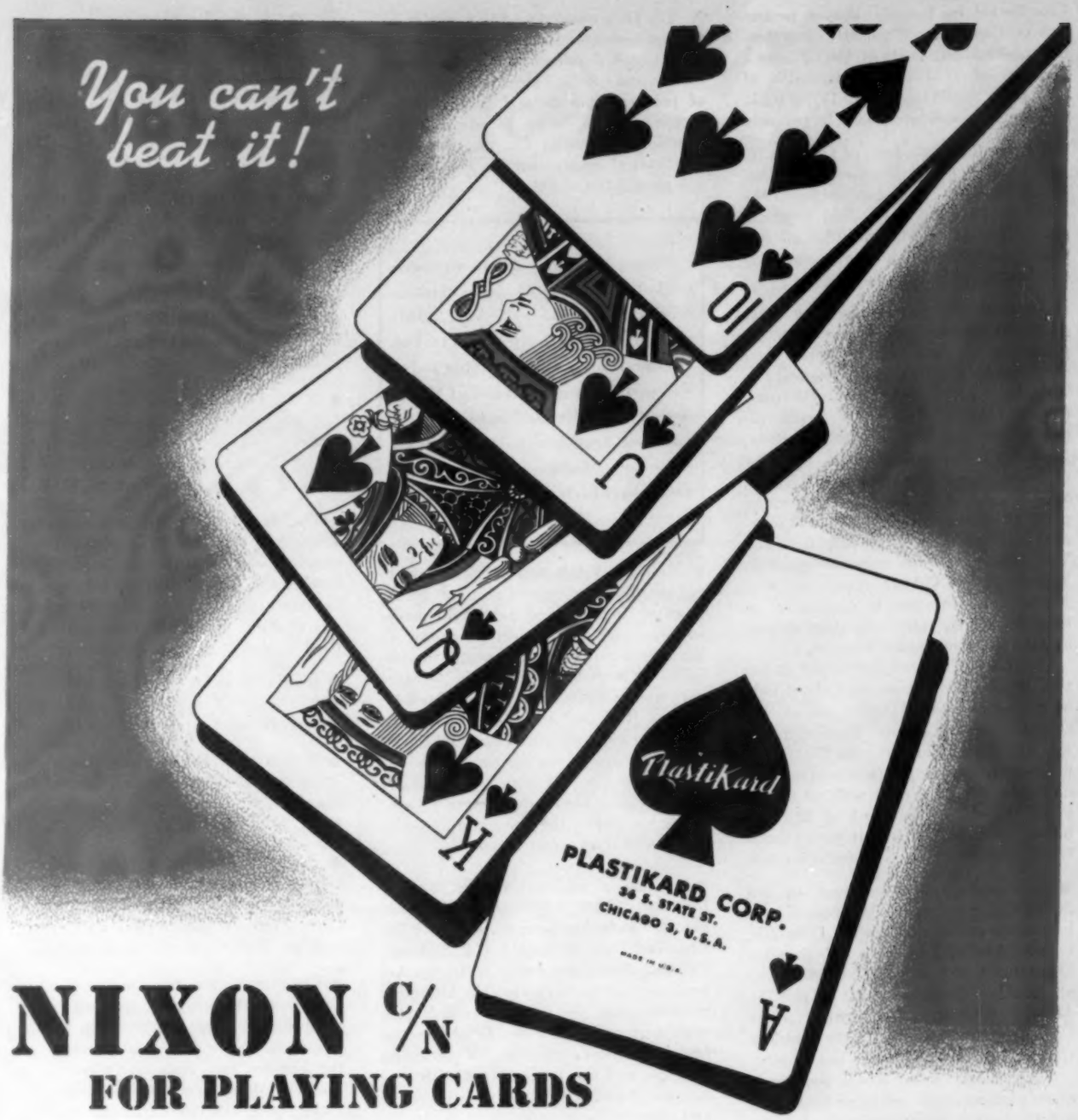
● The Plastic Div. of the Parker Appliance Co. has expanded its capacity for Saran injection molding.

● The Britto Pereira & Co. of Rio de Janeiro, Brazil, has been granted a license to manufacture plastic molded bonded plywood and other molded materials developed by the Duramold Division of the Fairchild Engine and Airplane Corp., New York 20, N. Y.

● Ethulose, a water-soluble cellulose derivative obtained by etherifying high alpha wood pulp with a mixture of different etherifying agents, is now being imported by George G. Johnston Co., New York 17, N. Y. At present it can be obtained in three viscosity ranges: Ethulose A, 25 to 60 cps.; Ethulose B, 100 to 200 cps.; Ethulose C, 500 to 1000 cps. It can be used as a film-forming material, sizing agent, binder, thickening agent, preservative colloid in aqueous solutions, and as an adhesive for paper and textiles. Completely neutral, Ethulose is resistant to frost and heat, is edible and non-toxic.

● General offices of the Monroe Plastics Co., Inc., Rochester 8, N. Y., have been incorporated with company plant there.

● A new alloy called Modaloy has been introduced by Trethaway Associates, New York, N. Y. It is recommended for molds for casting low-temperature-fusing plastics, rubber molds, wax molds for precision casting process, models for engraving machines, master patterns, forming dies for thin sheet metals and thermal plastics, proof casting of molds, forging dies, chuck



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FOR PLAYING CARDS

Before a Nixon Plastic was selected for "Plastikard" playing cards the material was given a test comparable to a full year of normal playing. As a result, the manufacturer guarantees the cards against original factory imperfections in material and workmanship for one year. These cards are dirt resistant and will keep clean through many games of play. When necessary, they can be easily cleaned with a soft cloth and cold water and wiped dry with a towel. They cannot fray or "dog ear" because they are plastic clear through. The printed surface keeps its color and clarity under constant play. Perhaps you, too, have a manufacturing problem which could be solved by using a Nixon Plastic.

C/N CELLULOSE NITRATE
C/A CELLULOSE ACETATE
E/C ETHYL CELLULOSE

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jaws for holding irregular shapes, protective coating on wood patterns and core-boxes. Moldaloy melts at 430° F., has a hardness of 22 Brinell, compression of 8000 p.s.i., tensile strength of 11,500 p.s.i., shrinkage approximately 0.001 in. per inch.

● Paisley Products, Inc., of Chicago 16, Ill., a subsidiary of Morningstar, Nicol, Inc., New York, N. Y., has purchased the Adhesive Division of Certified Products Co. in Chicago. This includes all formulas, manufacturing processes, raw materials and finished products.

● Production of styrene plastic or polystyrene at the rate of more than 80 million pounds a year by early 1947 has been predicted by the Monsanto Chemical Co. To attain this record output, the company's Plastics Division is being expanded. Plant facilities at Springfield, Mass., will be enlarged and a major styrene plastic plant at Texas City, Texas, adjoining the 50,000 ton styrene monomer plant which the company built and operated for Rubber Reserve, will be installed. The purchase of the monomer plant in August for $9,550,000 from the War Assets Administration is contingent on approval by the Department of Justice and the Office of Rubber Reserve.

The Texas City installation will utilize two large buildings, used until about 1933 as a sugar refinery, which adjoin the styrene monomer plant. Styrene monomer will be piped directly from the styrene plant to the styrene plastic manufacturing unit. An adjoining dock with an 810 ft. berthing space and a depth of 32 ft. at mean low water will permit use of water transportation to eastern, western ports.

● New paint colors, resistant to sun fading and cheaper than compounds now in use, were announced by Dr. Donald F. Othmer, head of the Chemical Engineering Department at the Polytechnic Institute of Brooklyn, Brooklyn 2, N. Y., and Dr. Alfred F. Schmutzler, chemist of Harmon Color Works, at a meeting of the American Chemical Society in Chicago last month.

The scientists found it was possible to make pigment-in-oil pastes without using a surface-active agent, necessary in present methods. The new method of oil adsorption consists of adding an alkaline emulsion to an acid pigment slurry. The cause for greater resistance to fading which is not obtained at the expense of the brightness and color strength is the formulation of a chromium-Rhodamine B. compound which after its formation, forms a metallic salt of an organic color containing chromium. By boiling this metallic salt after its manufacture it is made more lightfast.

● Two graduate lecture courses, Paint and Pigment Technology and Oil, Resin and Varnish Technology will be offered for the fall and spring terms by the Department of Chemical Engineering of the Polytechnic Institute of Brooklyn, Brooklyn 2, N. Y. They are designed to acquaint returning veterans and graduate engineers with recent developments in the manufacture and specific industrial applications of paints, pigments and resin. Henry Fleming Payne, technical editor of the American Cyanamid Co. and instructor of chemical engineering at Polytechnic, will present the courses.

Subscribers may obtain an index to Volume 23 of Modern Plastics Magazine (Sept. 1945–Aug. 1946) without charge by writing to the Readers' Service Dept. This index will contain a general list of titles, listing by individual subjects and authors, together with page and issue of Modern Plastics Magazine in which the item appears.

● Stabilizer V-1-N, a stabilizing agent to prevent discoloration and chemical breakdown of vinyl chloride and vinyl chloride acetate copolymers when processed at high temperatures and exposed to sunlight, has been developed by the Advance Solvents & Chemical Corp., New York 16, N. Y. It is said to be compatible and soluble in vinyl resin solutions and can be used in lacquers and coatings based on these materials. It permits working of vinyl resins at high temperatures without decomposition of the resin and still produces clear transparent films.

● A class of aliphatic nitriles, derived from fatty acids and called by the trade name Arneels, has been marketed by the Chemical Div., Armour & Co., Chicago, Illinois. Recommended as softeners, Arneels are said to be compatible with most polymers, can be used in combination with a second plasticizer to obtain the best in physical properties for processing and use, and can be combined with coal tar distillates, coumarone-indene resins and other resinous materials.

● The annual meeting of the Society for Experimental Stress Analysis, including a symposium on Telemetering of Aircraft Flight Observations, will be held at the Hotel New Yorker, New York, N. Y., December 9, 10 and 11.

● F. W. McIntyre, president of the Reed-Prentice Corp., Worcester, Mass., has announced that a complete line of plastic injection molded machines and die casting machines are now manufactured in England under license with Alfred Herbert Ltd. of Coventry, England. Alfred Herbert has contracted with Th. and J. Daniels Ltd., also, Francis Shaw Co. and the Hydraulic Engineering Co. for the manufacture of these machines.

Personnel Changes

● Frank H. Hoyt, formerly with the sales department, Plastics Div., E. I. du Pont de Nemours & Co., Inc., has recently joined Shawinigan Products Corp., New York, New York.

● David Maxwell has joined Bertell Inc., New York 17, N. Y., design and development organization, as director of product development, firm associate.

● R. Weissman has assumed presidency of the new Plastic-Studio, Pittsburgh 10, Pa. He was formerly educations director at the Pittsburgh School of Plastics.

● J. D. Fennebresque and W. Ward Jackson have been appointed general manager and sales manager, respectively, of the Chemical Division of the Celanese Corp. of America, New York 16, N. Y.

● Dr. Harold R. Mighton and Dr. Thomas G. Fox, Jr., have joined the research laboratory of the Goodyear Tire & Rubber Co., Akron, Ohio, to help expand fundamental research on synthetic rubber and plastics. They will work under Dr. Paul J. Flory, high polymer expert.

● E. C. Hawkins has been placed in charge of the Chicago branch office of the John S. Barnes Corp., Rockford, Ill.

● J. W. Veeder has been named as advertising and sales promotion manager of the Lumite Division of the Chicopee Mfg. Corp., New York, N. Y.

● F. Faxon Ogden has been appointed manager of special products sales development, Merrimac Div., Monsanto Chemical Co., St. Louis 4, Mo. and J. J. McCarthy manager of chemical sales development.

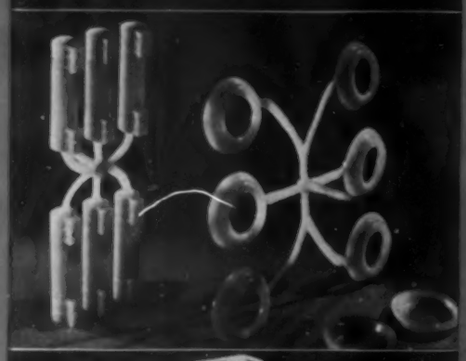
● Charles W. Palmer, vice president of Canadian Celanese, Ltd., and member of the board of directors, has been elected executive vice president and a member of the Finance and Executive Committee. William McC. Cameron has resigned as a vice president but will continue as director and member of the Finance and Executive Committee. William Ashworth is vice president in charge of sales.

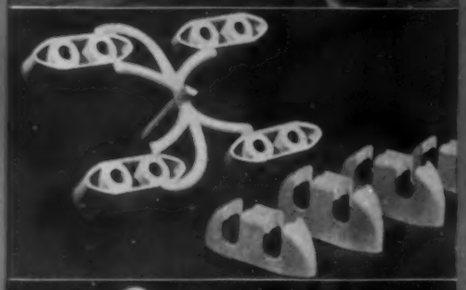
● Orville O. Kenworthy has been added to the staff of the Color Division of Ferro Enamel Corp., Cleveland, Ohio. He will engage in research and development of inorganic coloring materials for plastics, glass and pottery.

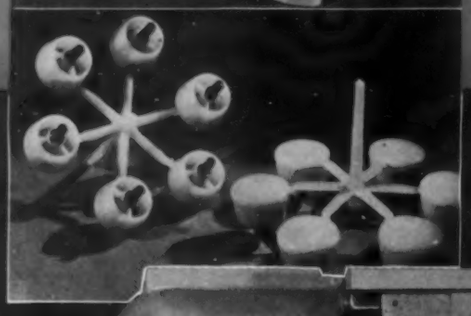
● Robert C. Fedanzo has been appointed the new general manager of Omega Plastics Co., Newport, Indiana.

● Dr. Robert M. Evans, who has been manager of the Atomic Energy Operations Division of E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del., was recently named assistant manager of the in-

AVERAGE CYCLE TIME
ONLY 26 SECONDS
ON THESE MOLDED PARTS







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Built to produce a multitude of small thermoplastic parts, the H-P-M four ounce injection molding machine is being widely selected by molders demanding high quality parts, low production costs and high speed operation.

The operating features of the H-P-M four ounce machine are legion . . . fast plasticization with two zone electric heat; straight-line hydraulic mold clamp, providing positive mold sealing, rapid die change-over and many other cost saving features. H-P-M injection machines are powered by the reliable H-P-M operating system. All hydraulic pumps, valves and controls are designed and built by H-P-M, guaranteeing undivided responsibility to the user.

For dependable, maintenance-free service, choose H-P-M "all-hydraulic" units built in standard sizes of 4, 9 and 16 ounce capacity. Machines can be shipped promptly from stock.

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Representatives in other principal cities.

Write today, on your company letterhead, for a free copy of H-P-M Bulletin 4502, describing the outstanding production features of this four ounce H-P-M all-hydraulic unit.

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Self-Contained • All-Hydraulic

INJECTION MACHINES

FOR MOLDING THERMO-PLASTICS

REVOLUTIONIZING PRODUCTION WITH HYDRAULICS SINCE 1877

dustrial division of du Pont's Plastics Department. Other changes include the appointment of CALVIN R. MACBRIDE as assistant manager of the products division of the Plastics Department and the return of DR. C. LALOR BURDICK after a year in Mexico City to head a special "High Polymer Committee" to study and coordinate company research and manufacturing activities concerned with nylon, plastics and similar polymeric compounds.

● JOSEPH MONAHAN has been appointed sales representative for Denison Engineering Co., Columbus 16, Ohio, in western and northwestern Michigan.

● WILLIAM F. CONDON has been appointed sales engineer of Shaw Insulator Co., Irvington, N. J. ERNEST J. CSASZAR, has left that firm to become a partner in Eagle Tool & Machine Co., Newark, N. J.

● Bland Charnas Co., Inc., Yonkers, N. Y., plastics fabricators, has announced the appointment of ARTHUR J. FRANKEL as director of research, in which position he is presently developing new processes involving vinyl latices.

● Recent appointments at Northern Industrial Chemical Co., South Boston 27, Mass., include those of JOHN H. BEACH and DONALD M. GAWTHROP as sales representatives in the New York State and Philadelphia-Baltimore areas, respectively. JOHN K. BOOSAHDA is the new sales engineer in the Boston area.

● Paisley Products, Inc., Chicago 16, Ill., manufacturers of industrial adhesives, has appointed J. F. SEQUIN as representative in Texas and Oklahoma.

● ROLAND S. HIGGINS has joined Hydropress, Inc., New York, N. Y., builders of heavy hydraulic machinery and rolling mills, where he will be sales representative and head of the Detroit branch office.

● General Electric Co., Pittsfield, Mass., has announced the appointment of JOHN C. MORRIS as superintendent of manufacturing of the Resin and Insulation Materials Div. of the Chemical Department.

● J. W. BARNETT has announced his resignation as president of Barnett Inc., Atlanta, Ga., to become plastic consultant, manufacturers' representative and sales engineer for various firms in the four states surrounding Georgia.

● HARRY H. PURVIS has been named general manager of the new Lumite plant of Chicopee Mfg. Corp. at Cornelia, Ga. Five members of his executive staff will be J. L. HALL, plant manager; CHARLES RUDOLPH, head of research and development; W. T. TORGESON, office manager; HILLARY MCALLISTER and RANZIE TAYLOR, shift foremen.

● DR. JOHN R. BROWN, JR., has assumed his duties as director of chemical research of the Prolon Laboratory at the Pro-phylac-tic Brush Co., Florence, Mass. Previously he was assistant director at the Esso Laboratories, Chemical Division, Standard Oil Development Co.

● W. O. LIPPMAN has been elected vice president of Westinghouse Electric Corp., Pittsburgh 30, Pennsylvania.

● RUSSELL A. WALLACE, formerly in charge of plastic and chemical exports for the Celanese Corporation of America, has resigned to become a partner in the Dussi-Wallace & Co., New York, N. Y. This company will act as the American branch of several large enterprises in Southeastern Europe, Near East, Latin America, representing plastic, chemical, electrical lines.

● Remler Company, Ltd, San Francisco, Calif., electronic and plastic firm, has purchased the stock of retiring president, E. G. DANIELSON, with ROBERT COLEMAN GRAY becoming sole stockholder and assuming presidency of the reorganized firm.

● Recent field engineering personnel changes of the Cincinnati Milling & Grinding Machines, Inc., Cincinnati 9, Ohio, include the appointment of JOHN E. LYNCH as manager of the New York office, and of CARL M. BEACH as manager of the Detroit office. E. F. RENDER has been transferred from Syracuse to Detroit and W. KENT MATHIAS to Syracuse.

● H. WEINRAUB has resigned as senior technical assistant in charge of phenolic molding material formulation for Bakelite Corp. to organize the Plastylite Corp, Plainfield, New Jersey.

● After three and a half years in the Navy, LT. COMDR. WILLIAM R. BOWEN has returned to Farrel-Birmingham Co., Inc., Ansonia, Conn., and is now manager of the branch sales office at Akron, Ohio.

● CAPT. SIDNEY ARIS, recently returned from the Army, has been appointed sales manager of the Industrial Div., Bland Charnas Co., Inc.

● COL. HARRY A. JOHNSON has rejoined the Westinghouse Electric Corp. as Micarta and insulation specialist, headquartered at San Francisco, Calif.

TEACHING A CHILD TO WORK WITH plastics pays dividends in the future and gives him an early appreciation of plastic materials.

It's being done now with plastic handicraft kits—the better ones based on a knowledge of child psychology as well as modern teaching methods. Some contain only one material and no tools. Others contain various materials, tools and instruction booklets. These booklets give a background story about each particular plastic in the kit, telling him why it is to be handled in a certain way and encouraging him to use his ingenuity in approaching the project.

Six basic musts are now established in kit development: 1) clean, not "scrappy" looking materials; 2) pieces of many sizes; 3) many bright colors; 4) enough cement and coloring material to make up every piece; 5) additional material at low cost; 6) packaging designed to keep material in order in the box.

We are indebted to Educational Materials, Inc., Alex Tennenbaum Mfg. Co.; Plastic Enterprises and Kosto Plastikits for the information in this short article.

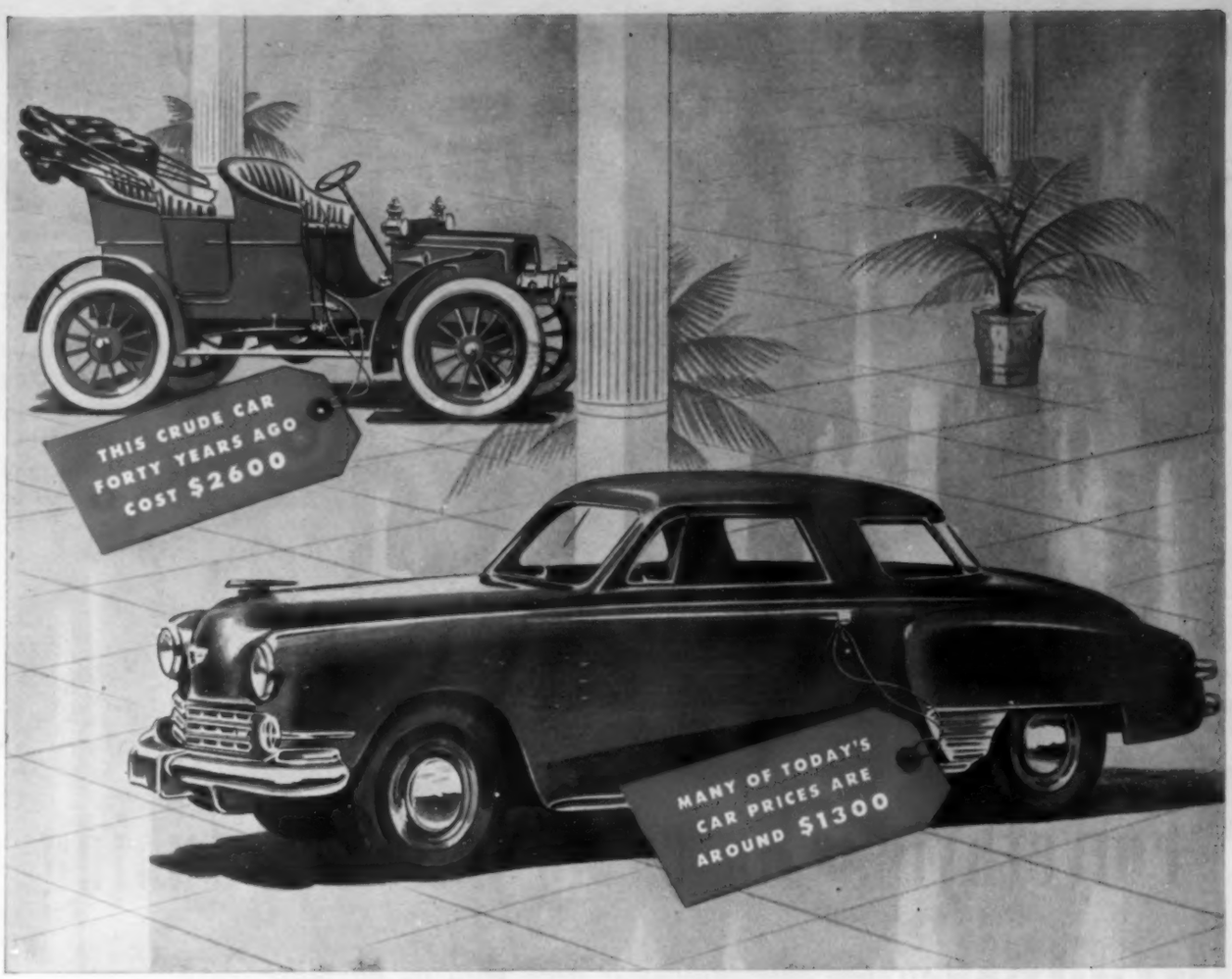

Figure it out . . . Work Pays!

Four Cars "for the Price of One"

In terms of automobiles, see how work pays! Production 40 years ago was less than 50,000 cars annually. Prices then were more than twice the cost of cars after production had climbed into millions per year. *Values* today are many times greater. *Purchasing power* of the average wage-earner has more than *doubled*. Conservatively stated, this means that the public gets the equivalent of about *four* fine motor cars today for less than the relative investment in *one* in 1906!

Many other examples of how work pays could be cited. Only through increased production . . . not slow-downs or idleness . . . can real income-increases be attained. Distortions of that truth may persist, but the fact remains. And the public must be reminded, repeatedly, that only through increased production can the masses benefit by technological advances of recent years in industry.

To help manufacturers improve their production and their products, MOSINEE paper technicians are ready to work. Call us!

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Essential Paper Makers

Please address your letter "Attention Dept. 1"

Three steps are shown in the manufacture of lead-in tubing. Lower tubing is inner polyethylene core over which a copper braid is woven (center cord). This assembly is then put through an extruder and covered with polyethylene

Polyethylene in radio antenna tubing

Extruded polyethylene is used both as an inner core and an outer covering for metal conductor

CHALKING up another mark of versatility for polyethylene is a radio antenna shielded lead-in tubing manufactured by the American Metal Hose Branch of the American Brass Company. Before this plastic material was tried, antenna lead-in tubing was composed of fabric over the center conductor, a covering of tinned copper braid over the fabric and finally an outside jacket of woven fabric.

Although this assembly was adaptable, it did not meet all the conditions to which wiring of this type is subjected. It could not withstand water, had poor electrical qualities and wore out in a comparatively short time.

Some material was needed that was waterproof, was cheaper to assemble than the fabric lead-ins and could be used in a wide range of temperatures. Polyethylene proved to possess these qualities and others—low capacitance, high Q, good flexibility and good extrusion qualities as well.

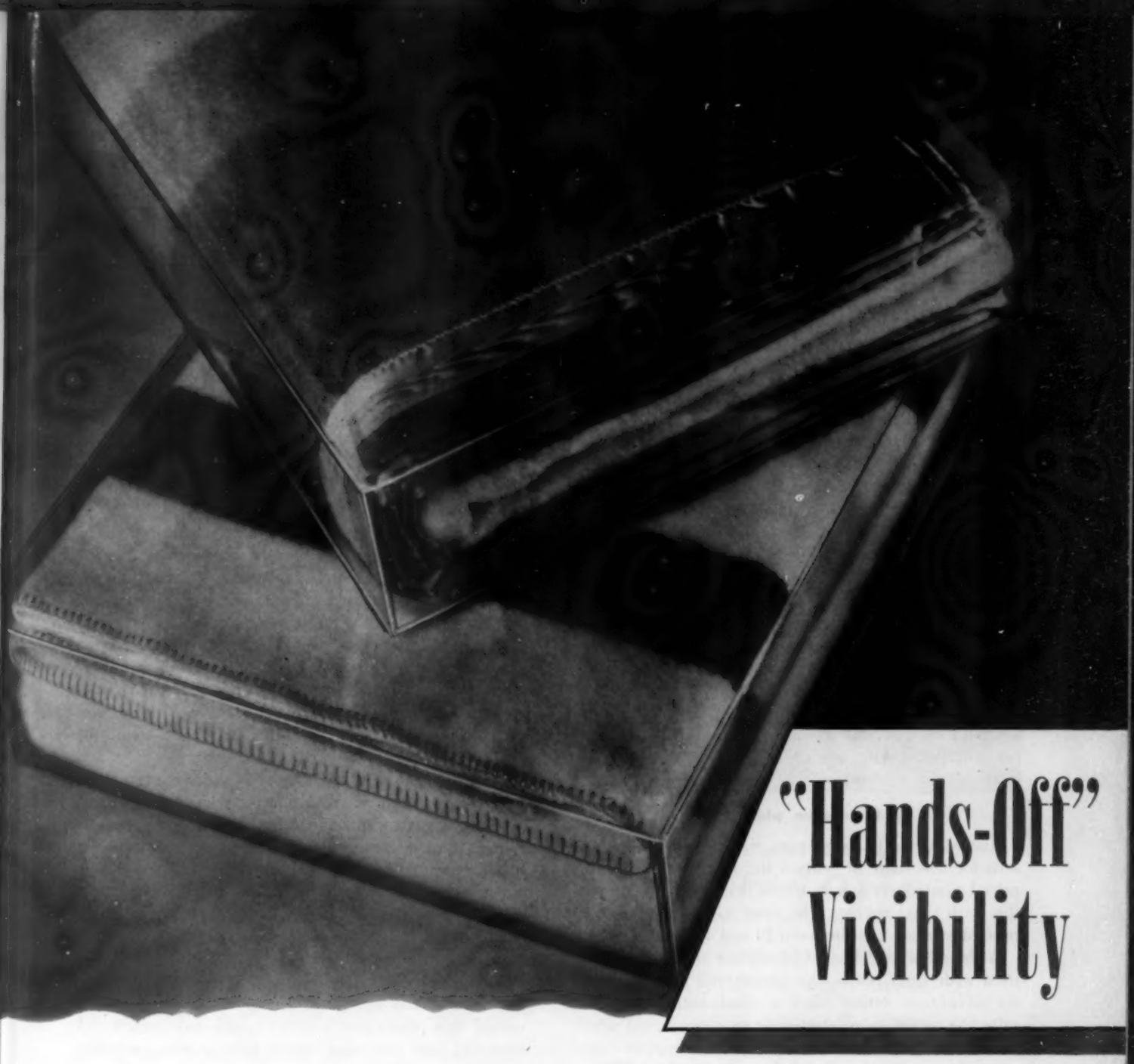
Assemblying the components

In making the new type tubing, Polythene PM-1 was selected for the inner core because it is stabilized and retains its electrical properties. It has an inside diameter of 0.125 in. and an outside diameter of 0.200 inch. A braid known as 24 by 6 by 0.006 in. tinned copper basket braid was employed over this polyethylene tubing core. Woven directly over the extended tube, it provides the electrical properties necessary in shielded lead-in tubing.

The entire assembly is put through an extruder and covered with a final coating of Polythene PM-2, a formulation which was selected for the fine surface appearance it gives the finished lead-in tubing. The outside dimensions of this last polyethylene coating are 0.270 inch.

This tubing is eventually finished with a center conductor, usually a 0.010-in. wire, and end fittings which are crimped on and soldered to the center conductor. The American Brass Co. does not, however, do this assembly work.

Automobile radios usually have very short antennas and because of this must be relied upon to pick up a great deal more than is required of the ordinary home antenna. That is why good shielded lead-in tubing is so essential to proper operation of autombile radios.



"Hands-Off" Visibility

NO need to choose between *protecting* merchandise against shopwear, dust, handling . . . and *displaying* it prominently, invitingly, so that customers simply can't pass it by. Not any more!

Packages fabricated of Eastman Acetate Sheet provide all the protection any merchant could ask for. At the same time—thanks to their transparency, their sparkling optical clarity—they display products at their best . . . show them attractively, in their true colors . . . offer customers a standing invitation to stop, look, and buy . . .

The current supply of Eastman Acetate Sheet is not sufficient to meet the continually increasing demand. But the Kodak Transparent Packaging Laboratory, in Rochester, is always available to demonstrate fabrication methods.

Cellulose Products Division

Eastman Kodak Company, Rochester 4, N.Y.

Eastman Acetate Sheet

Attracts . . . Protects . . . Sells

Kodak

A new petroleum product for plastics

A PLASTICIZED vinyl paste or plastisol that can be used as a coating or elastomeric molding compound can now be produced for a variety of uses. This plastisol, virtually a molding powder in paste form, consists of a compound containing vinyl resin and 50 percent or more of S/V Sovaloid C, a petroleum derived plasticizer, in contrast to most vinyl compounds which are more than 50 percent resin. It would be particularly practical for processors who do not wish to do their own compounding, although they may add pigments if desired.

Greatest potential interest to date has been in its use as a film for fabrics to which it may be applied by roller or knife coating methods in almost any desired thickness on simple coating equipment in any textile converting plant. Used as a free film it would be necessary to spread it on a metal plate and then strip off. Considerable work in the use of plastisols in the production of complicated molded articles for varied purposes would indicate that it possesses possibilities as an elastomeric molding powder of potential merit.

The plasticizer is available from Socony-Vacuum Oil Co. and can be compounded readily into plastisols. At some later date, undyed plastisols may be made available by this supplier.

A low-price plasticizer

According to the developers, S/V Sovaloid C, which sells for less than 10 cents a lb., is one of the lowest priced plasticizers known which is completely compatible with vinyl resins. The most widely used all-purpose plasticizers cost between 20 and 40 cents a pound.

Although a less efficient plasticizer than other types used with vinyl resins, this property is pointed out as an advantage rather than a disadvantage. It permits the use of more plasticizer in a compound which results in a lower cost than when using higher priced plasticizers and the physical properties of the compounded resin are said to be equal to those produced when using lesser amounts of other plasticizers.

S/V Sovaloid C may be used either as a partial or complete replacement for other plasticizers. In both these applications, tensile strengths equal to those obtained from other plasticizers are obtained when using larger quantities of S/V Sovaloid C. In these relatively high concentrations, there is no evidence of exudation of the plasticizer from the finished product. It is further stated that none of the inherent abrasion resistant properties of vinyl resins are impaired by the use of this plasticizer. Low temperatures cause the resins to become stiffer when using this plasticizer than they do with certain other types of plasticizers. Laboratory tests have shown, however, that there is no tendency for compounds containing this plasticizer to crack when flexed at temperatures as low as −70° C. To obtain equal flexibility at room temperature a vinyl resin requires larger amounts of S/V Sovaloid C than it does of other plasticizers.

Standard tests

Standard tests with solvents such as water, oil and gasoline show that this plasticizer isn't easily extracted from a vinyl compound. Laboratory tests indicate that the burning rate of compounds containing this plasticizer compares favorably with that of compounds containing so-called flame-retardant plasticizers in equivalent amounts.

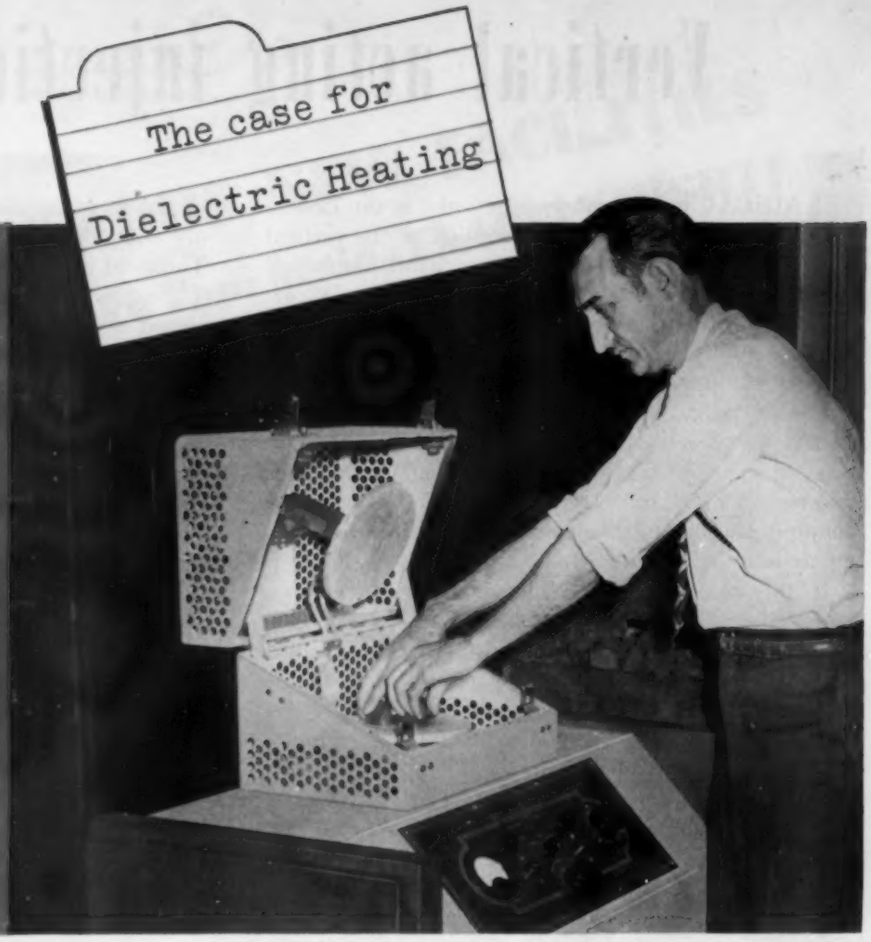
One of the most gossipy complaints concerning vinyls has been the criticism that they attract lacquer when in contact with painted surfaces for long periods. Such reactions have been caused by plasticizers migrating out of the resin and acting as paint removers. S/V Sovaloid C being a nonsolvent for ordinary types of finished surfaces completely removes this objectionable quality of some of the esters. It is also asserted that vinyl compounds of equal flexibility show less tackiness when plasticized with S/V Sovaloid C and this again is credited to the fact that the plasticizer does not act strongly upon the vinyl. There is no denying that this plasticizer is more volatile than ester plasticizers and is consequently recommended for use in sheeting that is 15 mils thick or more, rather than in lightweight stock. In thin materials such as 4 mils, it is used only as a partial replacement for other plasticizers. When used with thick sheeting, a remedy for the high volatile and resulting loss of plasticizer would be to slightly overplasticize the initial compound to allow for that fraction which is most easily lost in aging. Because it is likely to be discolored by the action of light, the exclusive use of this plasticizer in vinyl compounds which, by reason of their use, must remain light in color probably should be avoided.

As a total plasticizer for applications where it is desired to have a flexible compound below 32° F. S/V Sovaloid C is not recommended because it stiffens to a much greater extent than other plasticizers at low temperatures. However, the compound does not become brittle and in instances where stiffness is unobjectionable the compound would be satisfactory at low temperatures.

It has a characteristic odor which is objectionable for some purposes but actually favorable in others. It is slightly reminiscent of kerosene and can be mitigated by the addition of small amounts of other agents.

As a plasticizer it is presumed that its future lies in such end products as extruded sections to replace rubber in automobiles and in electrical installations, and for handbags.

Electronics hikes production 1/3 cuts mold size 4/5



When you can whittle the time cycle for molding thermosetting plastics by 36%, obtain a better product and reduce costs of all phases of the operation, you've gained an effective new tool for modern production. Here is a case study showing how you can improve your production.

Hot-water bottle stoppers molded by the new process were produced 1/3 faster with a mold only 1/5 of the size of the previously-used compression mold. Thread tolerances were maintained accurately.

So successful is this new system that one manufacturer using r.f. preheating saved more than 66% of his previous mold costs alone! The flexibility of dielectric preheating adapts it perfectly to many other operations, too . . . from making parts with long, slender holes to molding metal inserts into parts.

This exceptional versatility and effectiveness of dielectric heating is nothing new to plastics manufacturers familiar with the broad background of Westinghouse in helping develop radio frequency heating to new efficiency. Get all the facts today from your nearest Westinghouse office. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-02071

Here's Helpful Information

on both induction and dielectric heating . . . their principles and theories; where to use them; how to select them; actual case histories of their use. Write today for your copy, on your business letterhead please. Ask for B-3620.

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PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Electronics at Work

Vertical acting injection mold

"RADICAL but extremely practical," is the Lester-Aetna Die Company's description of the vertical die attachment which is now available for all Lester injection machines, ranging from 4 to 32 oz. capacity. Briefly, the company has succeeded in perfecting a vertical acting mold, both halves of which move at the same time.

The operating secret of this new machine—and actually it's no secret at all for the moving parts are exposed to view—lies in the arrangement of the arms and toggles which translate the conventional horizontal action of the standard machines into vertical die opening and closing.

In this new attachment, the mold sections are not mounted on the platens as can be seen in Figs. 1 and 2. They lie horizontally between the platens, suspended by four toggle arms, two on each side, which have one end pivoted to the mold section and the other end pivoted to the stationary side plates of the die attachment. The operation is as follows:

When the attachment is in the open position (Fig. 1) the movable platen has swung the two sections of the mold on their pivoted toggle arms, separating them and moving one of them up and one of them down on the vertical guide pins which direct their movement. Both mold sections move, a feature not possible with the usual horizontal mold operation. In this open position the safety gate is opened automatically and the molded part can be removed.

When the movable platen travels forward, the halves of the mold approach each other, make contact and are wedged tightly together under enormous pressure. The mold is then ready to resist the shock of injection. The entire injection load is sustained by a specially designed wedge lock which removes all strain from the toggle arms.

Advantages claimed for the mold mechanism include:

1. Metal inserts can be easily and securely placed in a horizontal mold cavity. This gives greater assurance that they will not fall out when the mold closes (possibly ruining the mold). This feature is expected to speed and simplify the production of molded parts wherever inserts are essential.

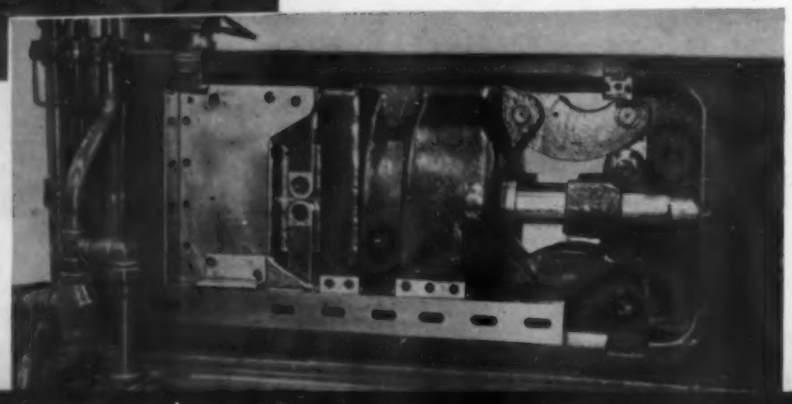
2. The molding of large circular or disk-shaped pieces demands a center shot on a vertical mold—unless one is willing to assume the problem of a side shot which generally means that the cavity is off center with resulting danger of deflection and flash. These difficulties disappear when the vertical acting mold is used: the shot enters through the parting line of the die with no danger of distortion or flash. Trimming is easy.

3. In conventional die opening machines, mechanical ejection of molded parts is only possible from the section of the mold attached to the *movable* platen. Consequently, ejector pin marks must often be left on prominently displayed surfaces. Ejectors can be located on *either half* of the mold with the new attachment. This gives the mold maker a greater choice in locating the ejector pins so that the marks they make will be on portions of molded part not normally seen.

PHOTOS, COURTESY LESTER-AETNA DIE CO.

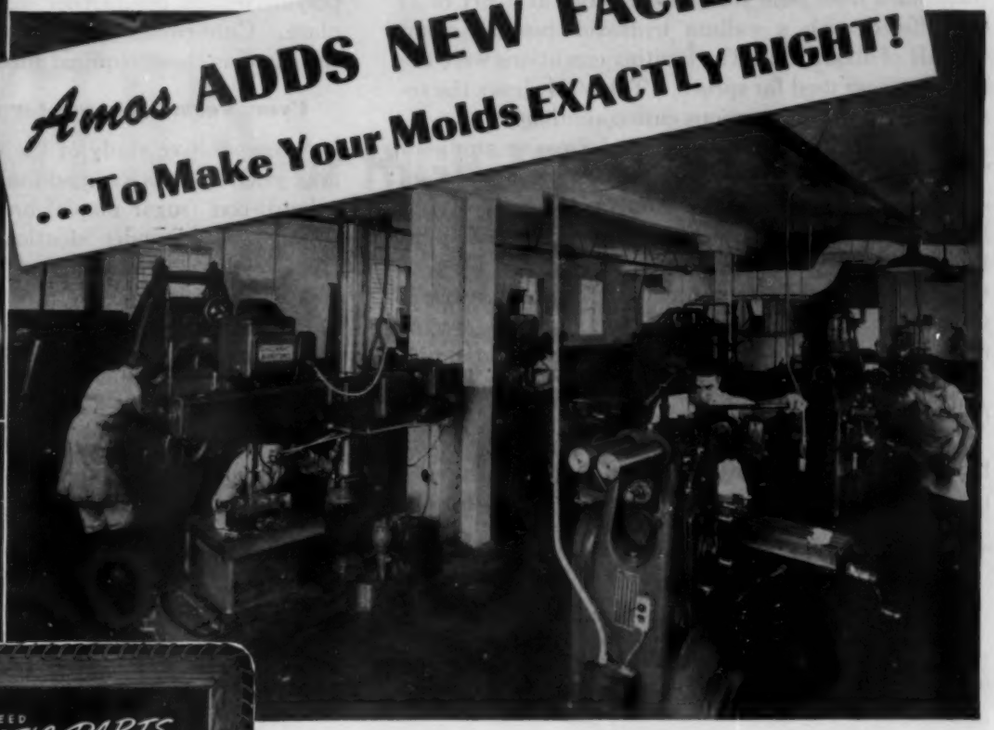
1—At left the vertically acting die attachment is shown in the open position. The movable platen has withdrawn, causing the 2 sections of mold to part moving independently on vertical plane

2—Below, the attachment can be seen in the closed position, both halves of the mold have moved toward each other, activated by toggles which are pushed by the forward travel of movable platen



These pictures show some of the men and equipment in the new mold shop added to Amos facilities.

Amos ADDS NEW FACILITIES ...To Make Your Molds EXACTLY RIGHT!



A completely new and modern tool plant in Indianapolis . . . with more new machinery to make molds for Amos . . . and four of the best mold-makers in the plastics industry to control this most important factor in your plastic molding job—that's the latest addition to constantly enlarging Amos facilities.

To do your plastic molding jobs exactly right, Amos insists that your molds *must* be engineered and built *right*—from beginning to end!

Complete and rigid control of your molding job, from engineering and mold-making to production and finishing . . . with every step handled by broadly experienced plastics engineers and specialists who excel in creating, tooling and producing injection molded parts and products—*that's the service Amos offers YOU!* Just send your drawings or write us what you have in mind to be molded in plastics—*Amos will do it right!*

AMOS MOLDED PLASTICS • EDINBURGH, INDIANA

Division of Amos-Thompson Corporation

Amos MOLDED PLASTICS...

CUSTOM *Molders of*

Plastic Parts and Products

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SOCIETY OF THE PLASTICS INDUSTRY

Wood treatment

(*Continued from page 153*) spruce series at a pH of 8; c) buffered with a sodium hydroxide-borax system[5] to a pH of about 9.5. The treating conditions were the same as those used for spruce. Table III shows the results obtained under various cure conditions.

The general conclusions reached from a study of Table III and from observations during treatment are similar to those found for the spruce series; namely, unbuffered urea-resin systems are not stable in acidic solutions (pH of 4.0 after treatment of oak) and much of the resin polymerization occurs before the wood is thoroughly impregnated, resulting in high apparent resin content without correspondingly high antishrink efficiency. Buffering at a pH of 9.5 was found to retard polymerization.

In the case of the borax, boric acid, sodium carbonate buffered system, the antishrink efficiency values were not so high as those obtained on Sitka spruce for the reason that the buffering capacity was not high enough to take care of the acidity of white oak (pH of 5.5 after treatment). Thus there was some tendency for resin polymerization before thorough treatment had taken place. Cure conditions, however, seemed to be about the same as those required for the Sitka spruce.

Urea versus phenol-formaldehyde resins

A comparative study of the urea-resin and the phenolic-resin systems was made on two species of wood, one a hardwood (sugar maple) and the other a softwood (Sitka spruce), under identical conditions. Matched cross sections were prepared from each species and treated with phenolic and urea resins at concentrations of 0, 5, 10, 15, 20 and 30 percent resin-forming solids. Interlake phenolic treating resin No. 1652 and a urea-formalin mix with a 2 to 1 formaldehyde to urea ratio, buffered at a pH of 8, were the resins used. Treatment was the same as described before and all samples were cured in a hot press for 20 min. at 315 to 320° F., followed by 24 hr. at 220° F. in the oven. Swelling

Table III.—Effect of Varying the pH and Curing Conditions Upon the Antishrink Efficiency of White Oak

Cure conditions		*Unbuffered*		*Buffered (pH 8.0)*		*Buffered (pH 9.5)*	
Temperature	*Time*	*Resin content after leaching*	*Antishrink efficiency*	*Resin content after leaching*	*Antishrink efficiency*	*Resin content after leaching*	*Antishrink efficiency*
° *F.*		%	%	%	%	%	%
Approx. 70	1 day	21.3	0	15.3	5.2	3.8	3.6
	10 days	21.4	0	15.4	5.2	3.7	6.8
220	3 hours	24.1	10.4	21.6	19.3	6.2	9.9
	20 hours	25.4	15.3	22.9	27.5	9.4	19.8
	10 days	24.9	26.4	22.1	35.6	12.0	28.6

LATEST BOOST IN THE REVOLUTIONizing of the small boat building industry is the redesigned Plastiboat with a one piece hull marketed by Plastic Boats, Inc. This boat is molded from Co-Ro-Lite, the rope fiber being impregnated with Durez. It is 9 ft. long, has a 50 in. beam and is 17½ in. deep amidships. The light-weight hull has high mechanical strength and will carry 1000 lb. dead weight. An expanded plastic flotation material is suspended under the fore and aft seats which, according to the company, makes the boat unsinkable.

PHOTO COURTESY DUREZ PLASTICS AND CHEMICALS, INC.

The hull, designed by Egmont Arens for use as a dinghy for a cruiser or yacht, as a fishing or duck boat, or for conversion into a sailboat, is molded to exact contours in one piece under heat and pressure. Exceptional strength is provided by this monocoque construction and the annual ordeal of scraping, calking seams and painting, which occupies so much time each spring, is eliminated.

Because of the phenolic resin used to bond together the millions of rope fibers, the hull is not affected by sun, water, marine borers and other fungi, or by temperature extremes.

Finished in marine colors, the Plastiboat is equipped with aluminum oarlocks and tow ring.

CONSIDER DOWTHERM for HIGH TEMPERATURE (700°) HEATING AT LOW PRESSURE

When high and closely controlled temperatures are necessary, Foster Wheeler Dowtherm heating systems offer many advantages – uniform temperatures, high rate of heat transfer, flexible design to permit heating *and* cooling in the same cycle. Further, Dowtherm systems do not require expensive pressure parts – pressure remains low even at 700°F, upper recommended working temperature.

If you are looking for a solution to some problem of high temperature processing, write for more detailed information to

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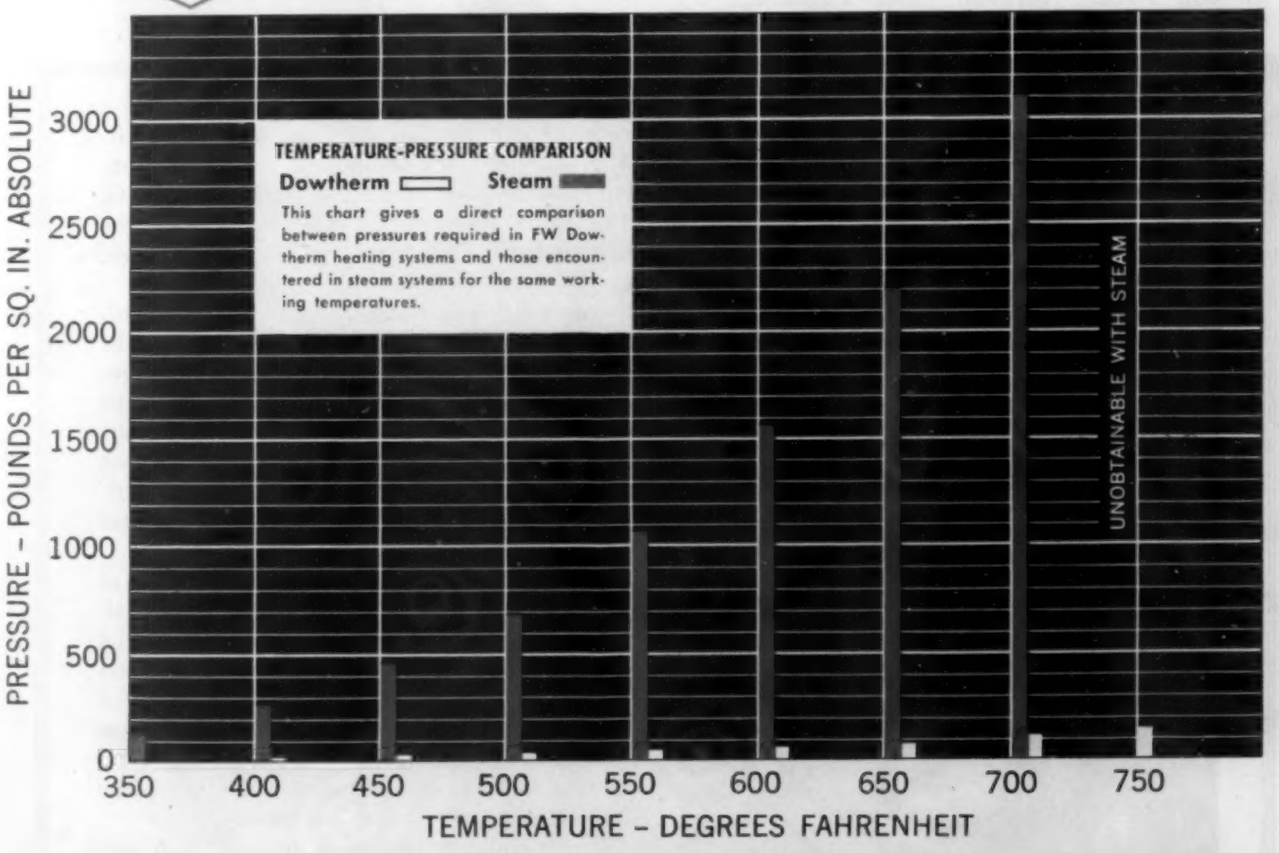

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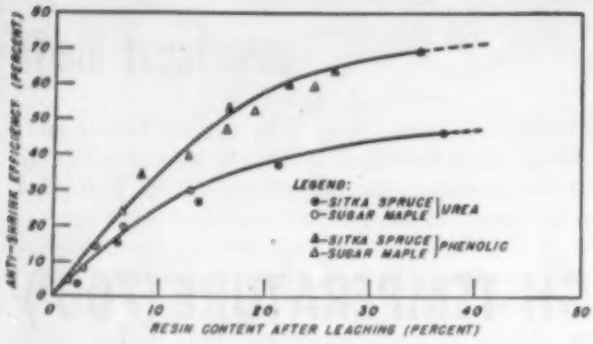

4—Variation of antishrink efficiency for Sitka spruce and sugar maple treated with urea and phenolic resins

measurements were then made in the usual manner.

Figure 4 shows the resin content-antishrink efficiency curves obtained on the two resin systems. At 30 percent resin content the urea resin gives an antishrink efficiency of about 44 percent, while the phenolic resin gives an antishrink efficiency of about 67 percent. In other words, urea resins are about two-thirds as effective as phenolic resins in reducing swelling and shrinking in wood. A phenolic-resin content of only 13 percent gives the same antishrink efficiency as a urea-resin content of 30 percent. The price advantage of urea resin-forming systems over the phenolic resin-forming systems is thus nullified by the fact that considerably less phenolic resin is required to give the same degree of dimensional stabilization. The lower resin contents of the sugar maple compared to the Sitka spruce are due to the fact that the void volume per unit weight of wood is much less for the denser maple and hence the solution take-up is less.

It should be remembered that these results were obtained under laboratory controlled conditions and on thin cross sections where uniform impregnation was assured. Treatment of larger wood specimens introduces treating, distribution and curing difficulties that will reduce the antishrink efficiencies obtainable with both urea and phenolic resins. Consideration should also be given to the relative durability or aging qualities of the two resins under conditions of high humidity, since the relatively good initial antishrink effectiveness of the urea resins may drop off rapidly with exposure to a warm humid atmosphere, predictable from the instability of urea-resin glues under these conditions.

Conclusions

The data indicate that optimum dimensional stabilization of wood with urea resin-forming systems is ob-

AIMED TO PLEASE MANY SPORTSMEN, farmers, firemen, auto tourists, railroad men and householders, the Reddylite electric lantern should be a friend in need to the many who will use it. A bright red ethyl cellulose or cellulose acetate butyrate housing keeps the lamp components. The Delta Electric Co., who molds both the case and the ring that keeps the lens in place, also assembles and markets the lantern.

Suspended on a metal base and equipped with a handle of the same material, the lantern can be hung by the handle or carried in use. Or if preferred, it can be stood on its base to light the scene of action. The swivel base affords 360° of adjustment, sending light to the exact spot where it is needed. Objects as far as 800 ft. away are picked up by the lantern that operates on a 6 volt battery.

The 2-piece molded housing is an example of plastics taking the place of another material. Here it was used not only because the material is sturdy but because it is dent- tarnish- and rust-proof. Plastic also made possible the use of a bright red for the housing—a color which makes for quick location and identification of the lantern and acts as a signal of danger when the lantern is placed at hazardous spots.

The Reddylite lantern is $6^1/_2$ in. high and weighs 37 oz. complete with battery. Used intermittently, the battery will last 80 to 100 hr.; burned continuously—65 hours.

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PLASTIC PRODUCTS

Furniture style . . . furniture comfort . . . furniture value . . . all are summed up in "Upholstered in RESPROID." Resproid Free Films approach perfection for upholstering. Rich in appearance . . . colorful . . . long wearing. Practical because easily cleaned and resistant to water, stains, oils and greases.

Resproid Transparent Films, too, for shower curtains, rain coats, draperies and countless household uses. Resproid Plastics find an honored place wherever beauty and quality are first requirements.

The name "RESPROID" stands for a multitude of quality plastic products.

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Genuine Resproid Plastic

tained with a treating mix having a ratio of formaldehyde to urea of 2 to 1. The treating solution should preferably be buffered at a pH of about 8 to avoid premature precipitation of resin-forming solids from the solution. Urea-formalin mixes are preferable to dimethylolurea, both from the standpoints of dimensional stability of the wood and reuse of the treating solution.

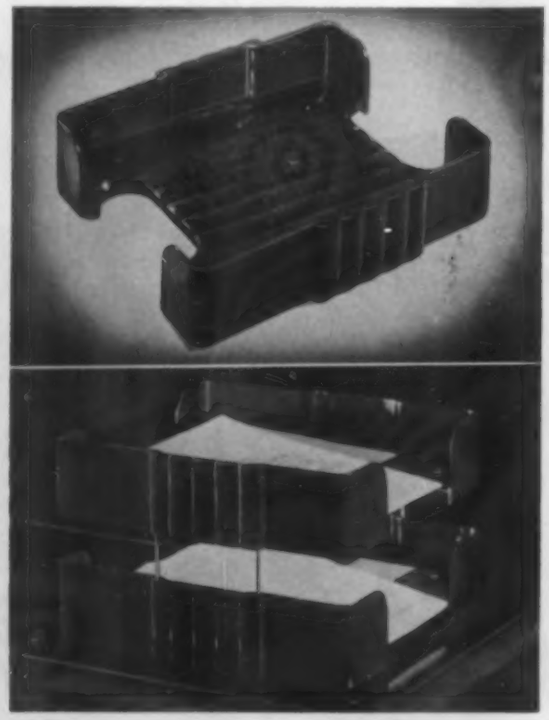
The curing temperatures necessary to obtain reasonably good dimensional stability of wood treated with urea resin-forming systems are considerably higher than those previously recommended. The use of lower temperatures is one reason why many who have tried the treatment were unable to get dimensional stabilization approaching optimum values given in this report.

The only known advantages of treating wood with urea resin-forming systems in preference to phenolic resin-forming systems are lighter color and a lesser tendency to impart odor or taste to materials in contact with the wood. The publicized price advantage of the urea resin-forming systems is nullified by the fact that considerably less phenolic resin is needed to give the same antishrink efficiency. This, coupled with the fact that urea resin-forming systems have to be carefully buffered, indicates that they are less desirable treating agents for wood when dimensional stabilization is the prime objective. Further data are needed to find out if any other properties are improved more by urea resins than they are improved with phenolic resins. Scanty data obtained up to the present time indicate that such improvements are not probable.

Executives' phenolic desk tray

The continual flow of papers and correspondence across a busy desk has long been a source of confusion to the harassed business man who must keep track of them. Such executives, and stenographers too, will appreciate the new Rock-Elite desk tray molded of phenolic for Rockwell-Barnes Company.

What constructive thinking can accomplish in the metamorphosis of even the most prosaic products from traditional materials to plastics is dramatically exemplified in this tray. And it is interesting to note that the many exclusive features of the tray could not have been economically achieved except through the plastic molding process, which produces two complete tray sections in a single compression press operation. Thus, the finished product represents not merely a plastic version of an item traditionally fabricated in wood or metal, but a refreshing new design concept.



The Rock-Elite tray was designed by Charles E. Jones & Associates, Inc., to combine practicality and handsome appearance in the standard desk type tray.

Identical upper and lower sections of the unit are compression molded by Chicago Molded Products Corp., which also produced the mold. The material used is walnut Bakelite phenolic with woodflour filler. The curing cycle on the 2-cavity mold is speeded up through the use of preheated preforms. Holes for metal tier posts are formed by core pins.

Though designed primarily for standard sized letter-heads, the plastic tray easily accommodates file folders. Because of its design, it offers greater capacity than ordinary trays, while the generous curved openings at each end and the arrangement of the metal tier posts on the sides rather than the corners permit access from either end of the tray.

The tray slopes downward to the rear, aligning the contents, and its lower surface is ribbed to eliminate fumbling for the bottom papers. Four rubber feet on the tray cause it to stand firmly and prevent scratching of desk or table tops.

PYRO *points the way*

When it comes to molding plastics with merchandising possibilities . . . products with "buy-appeal" as well as eye-appeal . . . Pyro points the way. If you are looking for fast-selling plastic specialties or if you have an idea which has merit, get in touch with us.

For fine workmanship specify **Pyro** *molded plastics*

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Manufacture of laminates

(*Continued from page 149*) at Troisdorf are heated by high-pressure water. Their capacities are as shown in the chart that follows:

Press	*Number*	*Size of platens*	*No. of daylights*	*Pressure*
		mm.		*kg./cm.²*
Paper laminating	2	1500 by 700	10	120
Paper laminating	1	1000 by 2000	5	120
Fabric laminating	1	1200 by 1200	5	90
Experimental	1	600 by 600	6	400
Variable pressure	1	3000 by 1500	5	(5000 tons)

Dynal pulp-sheet molding material N57/1409

A Dynal molding sheet is made in a paper-making machine. The process is in an experimental stage; a considerable amount of impregnated board was produced for molding the outer cases for submarine batteries. The procedures used in the preparation of the Dynal resin solution and resin pulp sheet are described in the following paragraphs.

Preparation of Dynal resin T8D (normal)—840 kg. (dry basis) of Resin T4N of approximately 90 cp. viscosity and 160 kg. of hexamethylenetetramine are ground in an MAG mill to pass a 4-mm. mesh screen The ground product is rolled in 15-kg. portions with the addition of 0.15 kg. of magnesium stearate to each portion during the charging of the mixture to the rolls.

5—A large phenolic-paper laminated transformer part

6—Battery containers molded at Troisdorf from pulp sheet

Rolling temperature

Front roll (20 r.p.m.), ° C.....65–70
Rear roll (15 r.p.m.), ° C.....40–50

Rolling time

Net, min.....3
Gross, min.....5½—6

The rolled sheet is laid on a wooden rack over a container. After cooling for 2 min. it is first broken up by hand and then ground. The material must be added slowly to the grinder in order to avoid heating with consequent increase in viscosity.

Preparation of the Dynal pulp sheet—Soda pulp is beaten with water in a hollander for a gross period of 60 min.; net 30 minutes. Powdered resin T8D equal in amount to the weight of dry pulp used is added 15 min. before the hollander is emptied. The material in the beater then has an approximately 10 percent solids content. The pulp is fed by way of a stirring tank with bucket wheel to a trough and then through a head-box to the screen of the machine for removal of the water. During this process, sufficient wash water (water flowing back from the screen) is added to the trough to dilute the pulp to a concentration of about 1 percent. For three-fourths of the length of the screen the water is removed by gravity and during the last fourth by suction boxes. The speed of the screen varies with the weight of the finished sheet as shown in Table V which follows. From the screen, the felted sheet goes to the Gautsch press; the pressed sheet has a solids content of about 32 percent. This sheet is passed through two wet-presses to increase the solids content to 40 to 45 percent, and is then dried on a cylinder dryer. The dried sheet is then wound on a reel and cut into sheets or into strips as needed. (*Please turn to next page*)

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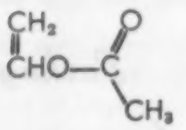

Boiling Range 71.8° to 73°C.

Vinyl Acetate can be polymerized to form resins with exceptional bonding qualities for wood, glass, metal and fibre

Containers:—

410 lb. drums; 62,500 lb. tank cars

—●—

ACETALDEHYDE

Used for the manufacture of phenolic resins and for polymerization to shellac-like products.

—●—

PARALDEHYDE

Used to modify the properties of phenol-formaldehyde resins by replacement of a portion of the formaldehyde.

For further information write to:

Table V.—Preparing Dynal pulp sheet

Dry weight of finished sheet	*Speed of screen*	*Drying temperature on cylinder dryer*
g./meter²	*meters/min.*	*° C.*
300–400	15	100–110
500	12	110–120
700	8	120–130

Urea resin solution H-144

The resin H-144 used in the manufacture of the Pollopas laminate mentioned in Table II is prepared as follows: a mixture of 600 kg. of urea, 2000 kg. of formaldehyde (30 percent neutralized) and 0.3 kg. of magnesium carbonate is refluxed for 30 min., acidified with 3 liters of 2 *N* formic acid and further refluxed for 20 minutes. After neutralization, 1100 kg. of water are removed by distillation under reduced pressure. Then 150 kg. of urea, 600 kg. of alcohol and 20 kg. of α,α'-dichlorohydrin are added. A clear solution results which develops a colloidal turbidity without precipitation after approximately 20 hours. If technical urea is used, no magnesium carbonate is added to the batch.

Solids content: 51 percent
Specific gravity: 1.15
Absolute viscosity: η = 136 cp.
Stability: after storage for 45 days, η = 198 cp.

Thermosetting rubber resins

(*Continued from page 156*) cured 40 min. at 310° F. and found to have the following properties:

Modulus at 300 % elongation	1760
Tensile strength at break, p.s.i.	2330
Elongation at break, %	380
Set at break, %	31
Shore hardness	72
Specific gravity	1.342
Abrasion Resistance (National Bureau of Standards test), % of A.S.T.M. comparison Standard "B"	50

An illustration of the use of rubber-resin compounds

3—Industrial applications of rubber-phenolic resins

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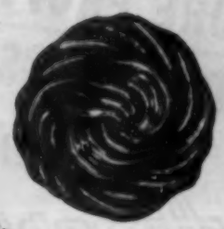

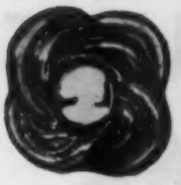

This patented process can be applied to the surface of most plastics to achieve a striking simulation of precious metals and special antique, two-toned effects.

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Now unusual beauty and rare two-toned effects can be imparted to molded pieces.

As molders, we make fountain pens of cellulose acetate that are the last word in precision injection molding.

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The simplicity of operation of the American Knife Chopper Grinder, makes it easy to operate by unskilled employees and hopper-fed safety door protects operator from operating hazards. Ruggedly constructed of welded steel frame construction—for heavy duty service. V-belt drive assures trouble-free power transmission, and alloy steel shaft mounted on alemite-lubricated pillow blocks provides for smooth, trouble-free operation. Adjustable tool-steel chopper blades. Screen openings—$\frac{1}{8}$"—$\frac{3}{16}$"—$\frac{1}{4}$"—$\frac{5}{16}$"—$\frac{3}{8}$"— and up. Minimum floor space required. Capacities—200 to 400 lbs. per hour.

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in materials designed for custom molding is Durez 13348. This is an experimental molding compound which has the properties shown in Table III as determined by current A.S.T.M. tests for thermosetting molding materials.

Table III.—Properties of Experimental Molding Compound Durez 13348

Properties of Molding Powder	
Plasticity	Very soft
Apparent density	0.37
Cure time	Approximately 50 percent slower than general purpose phenolics.
Properties of Molded Material	
Flexural strength, p.s.i.	11,000
Flexural deflection, mils ($\frac{1}{2}$ by $\frac{1}{2}$ by 5 in. bar)	175
Modulus of elasticity, 10^6 p.s.i.	3–4
Tensile strength, p.s.i.	6500
Izod impact strength, ft.-lb./in. of notch	0.50
Rockwell hardness, M scale	55
Specific gravity	1.24
Water absorption, %	0.6
Power factor at 1 MC	0.12
Dielectric constant at 1 MC	5
Dielectric strength, short-time test, v. per mil	270
Dielectric strength, step-by-step test, v. per mil	220

This compound demonstrates the utility of rubber-resin compounds in developing molding materials which possess an excellent combination of flexibility and impact strength in conjunction with good flexural strength and water resistance. The illustrations (Figs. 3 and 4) show some typical molded articles prepared from rubber-resin compounds.

In conclusion, it is hoped that the results here outlined may serve to illustrate the possibilities of rubber-resin compounds in the plastics industry. It is felt that further developments in elastomers and resins may lead to rubber-resin compounds of still greater utility.

4—These consumer items show applications of the softer compounds of synthetic rubber with phenolic resins

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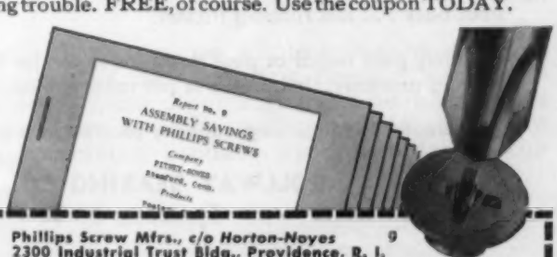

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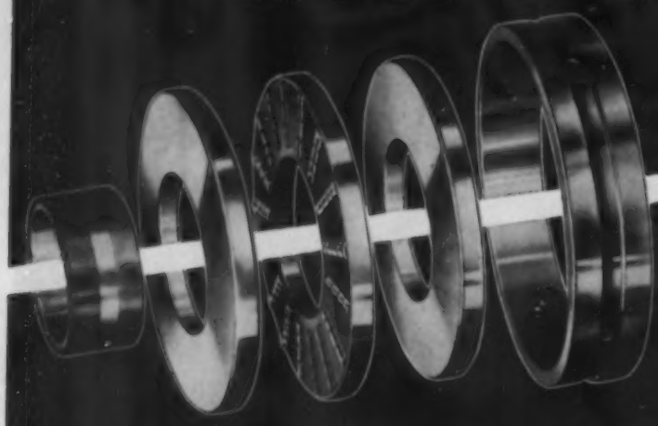

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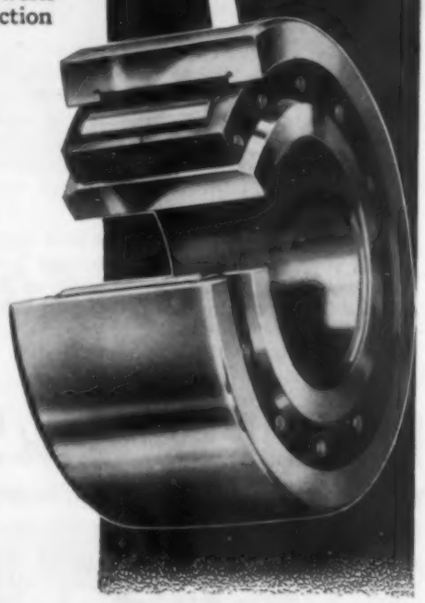

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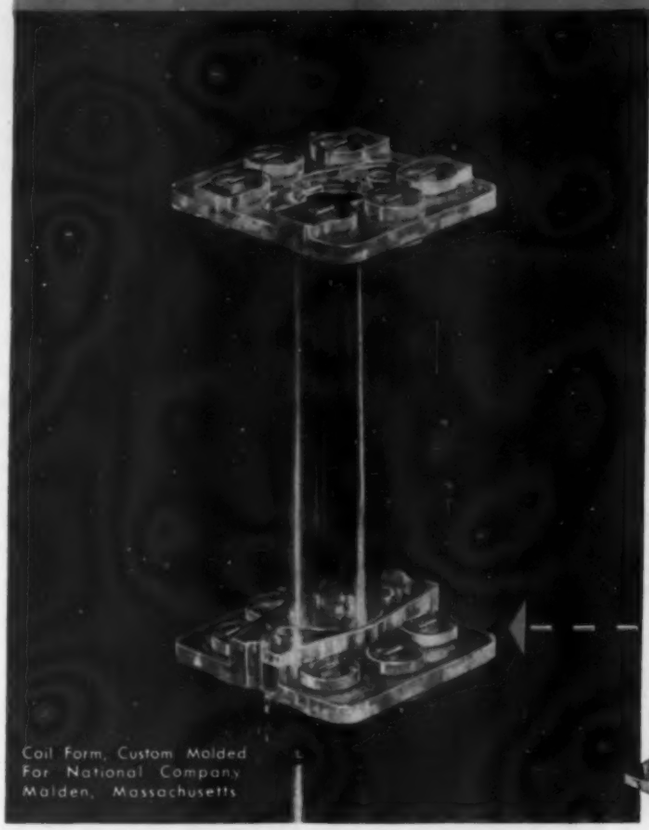

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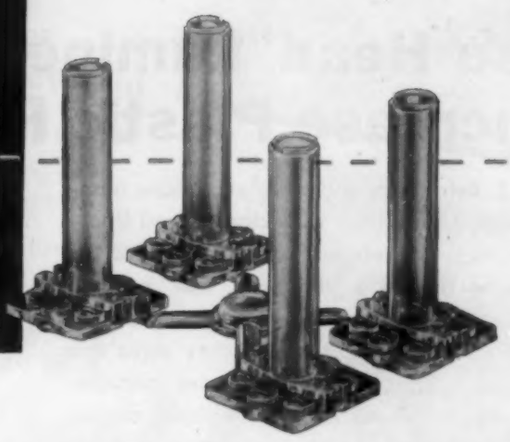

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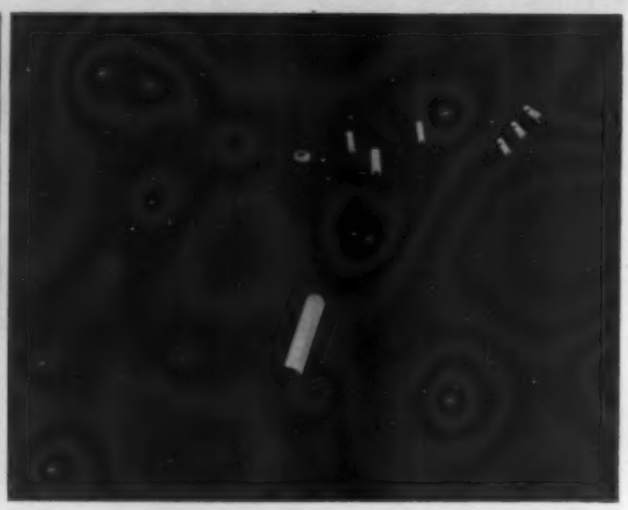

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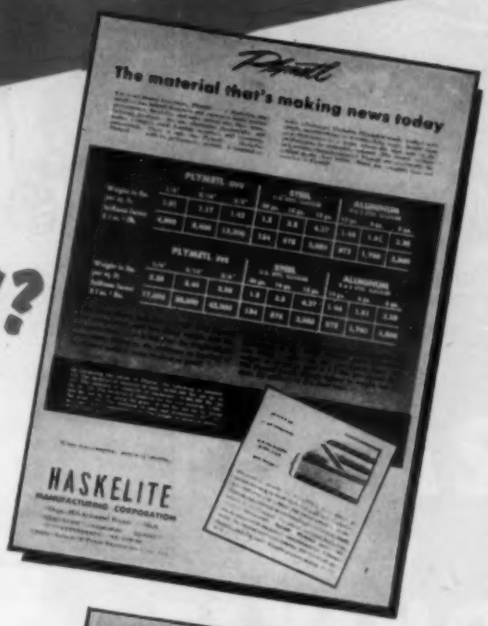

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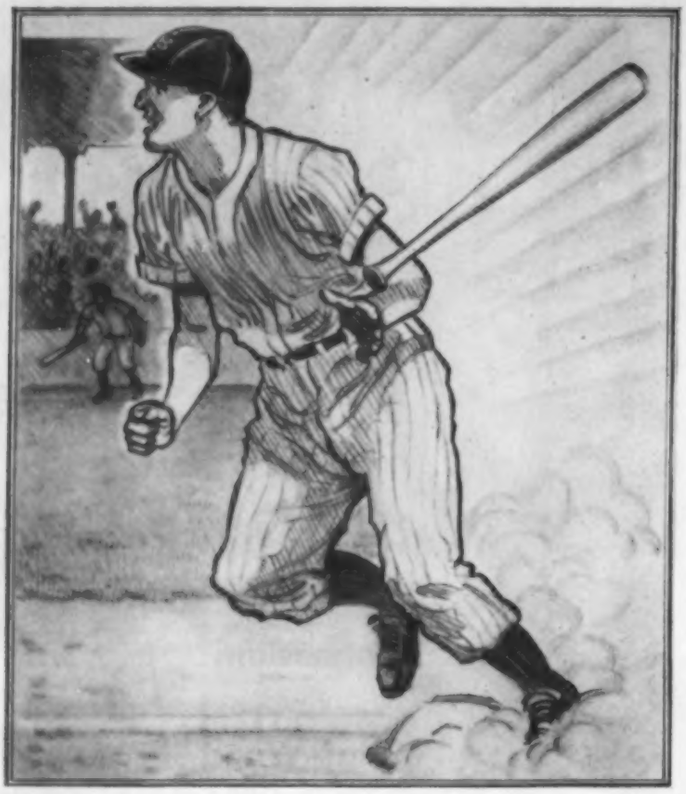

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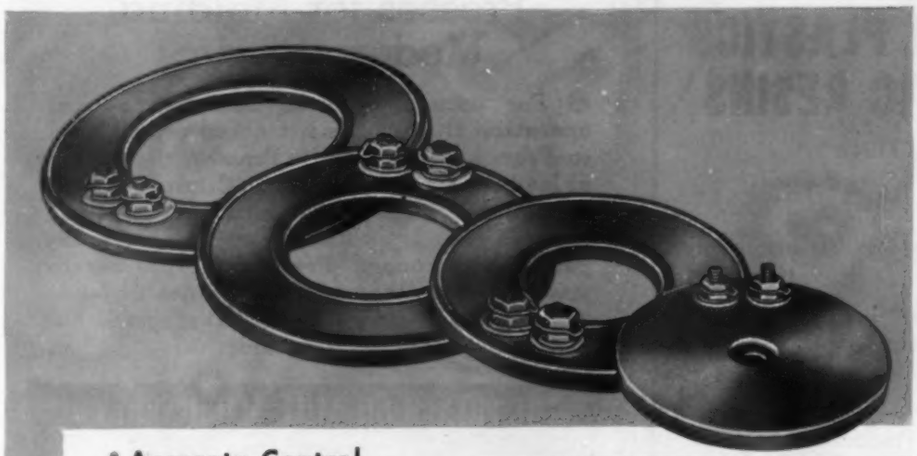

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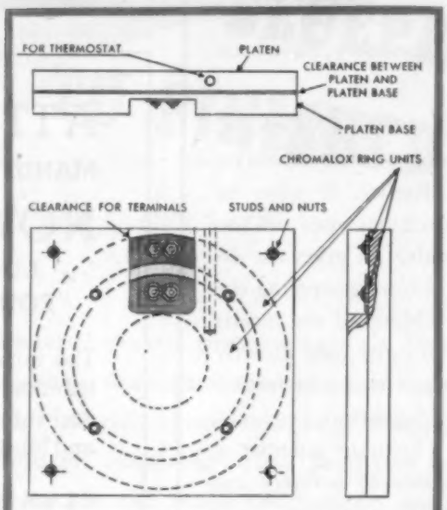

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CATALOG 42

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- Heat-absorption calculator; wiring and installation diagrams
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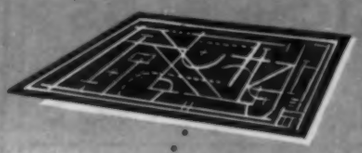

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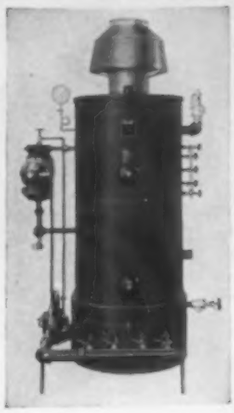

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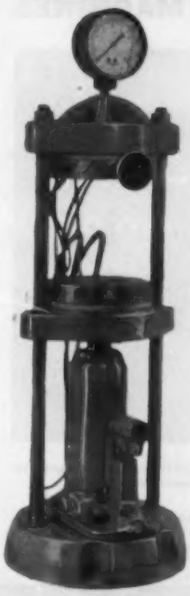

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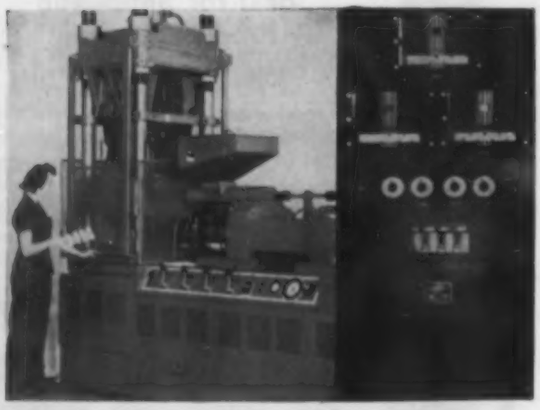

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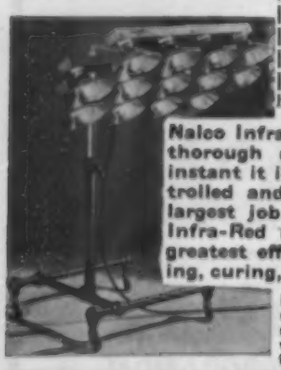

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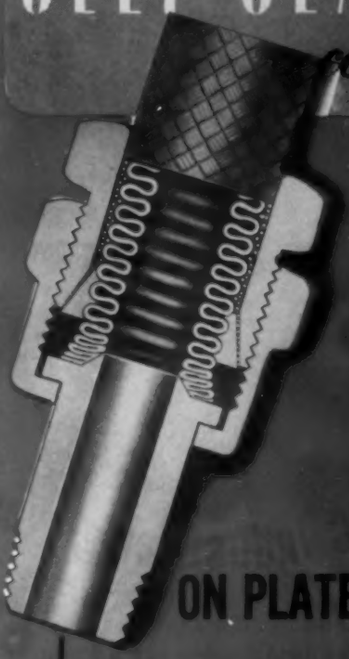

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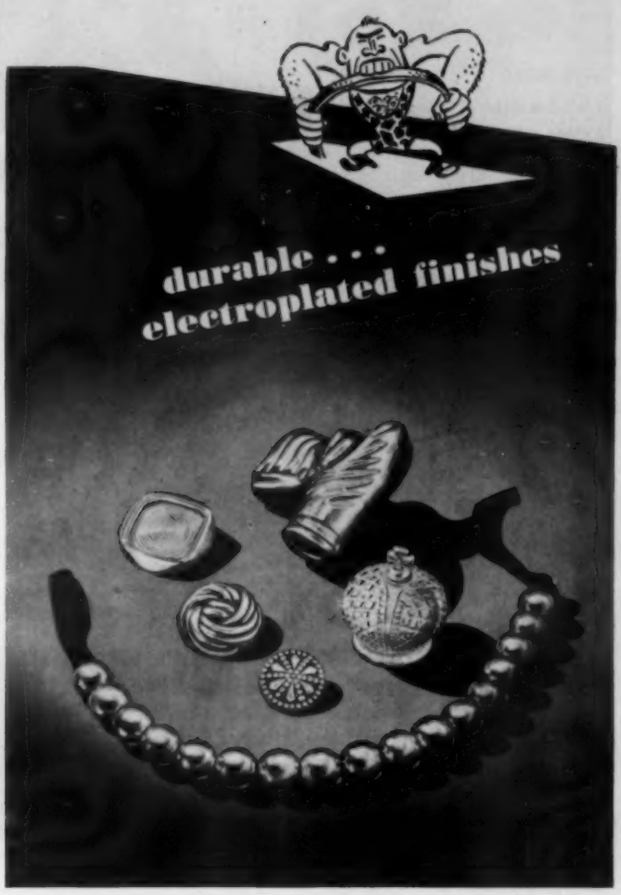

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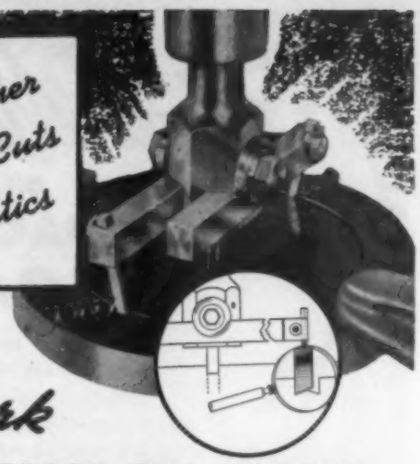

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Note thin wall section

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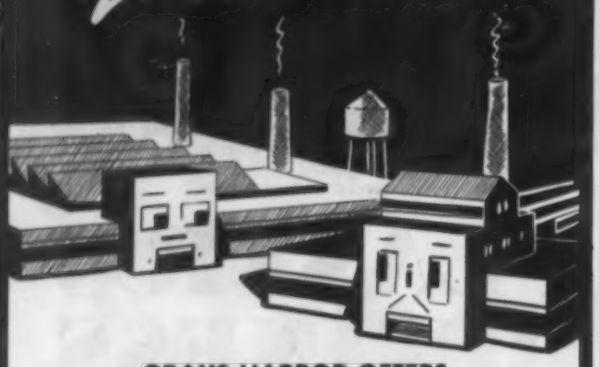

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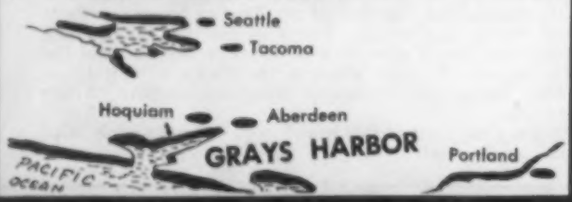

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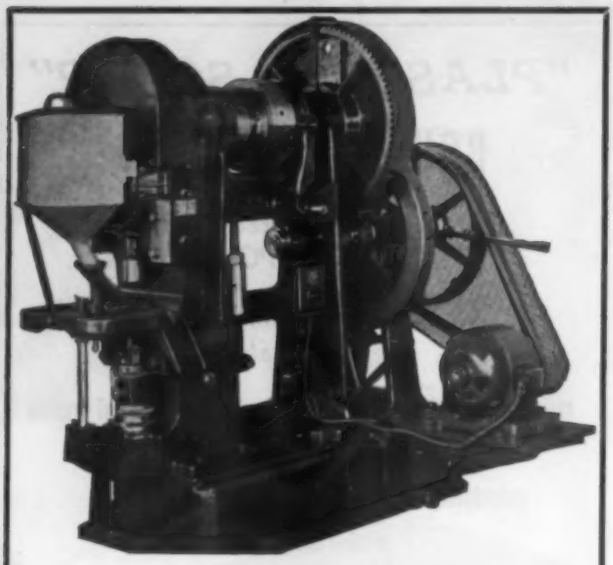

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Branch of the Industry	Name of Appliance	Use
Molders (Thermoplastic) Injection	VIBRA-VEYOR (Variable heat)	To preheat plastic powder automatically. To dry plastic powder automatically granule by granule
Molders (Thermosetting) Compression	PELLET-VEYOR (Variable heat)	To preheat pellets and preforms at the press as needed
Molders Injection	HOPPER-HEATER (Variable heat)	To warm up heavy metal of hopper of molding machine
Molders (Thermoplastic) Extrusion	STRIP-VEYOR (Variable heat)	To preheat strip rolls of vinylite, etc., automatically as fed to worm
Fabricators (Miscellaneous)	Special production equipment including vibrators, conveyors, stainless steel belts and electronic devices	To process various kinds of plastic material in bulk quantities
Material Manufacturers	BENCH-KIT In various sizes (Variable heat)	To soften sheets, rods, tubes and shapes for bending, forming, punching, etc. This includes Cellulose, Acetate, Methyl Methacrylate and Bakelite

(The time on most of the operations mentioned above averages five minutes)

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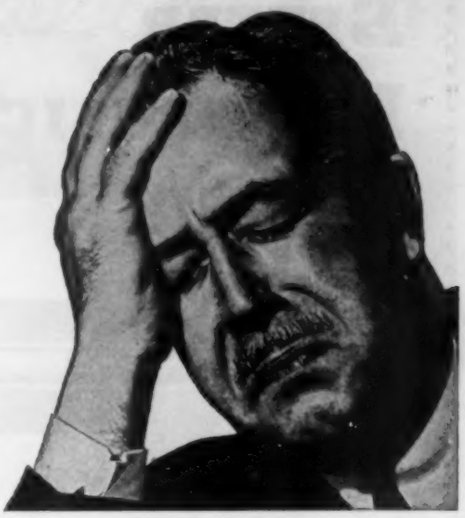

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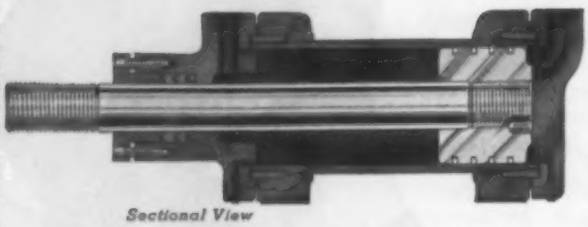

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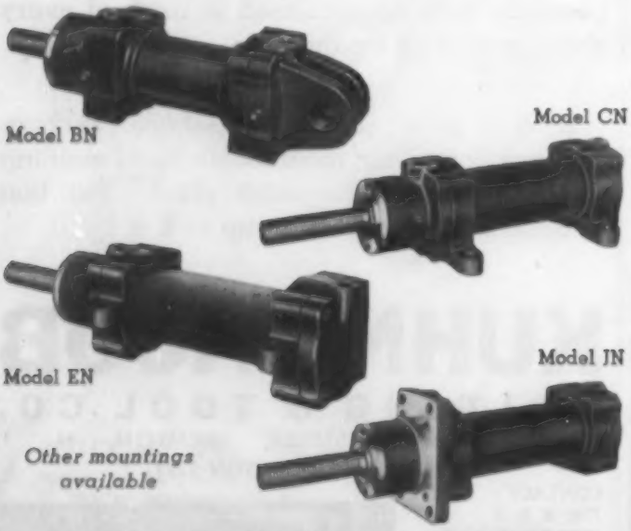

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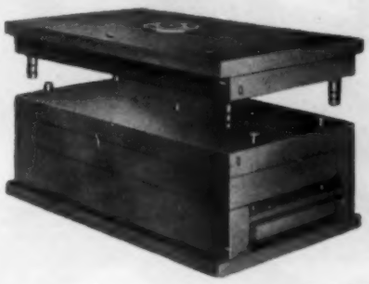

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Tapered Milling Cutters *Ejector Pins — Headed and Threaded*

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DME

DETROIT MOLD ENGINEERING COMPANY

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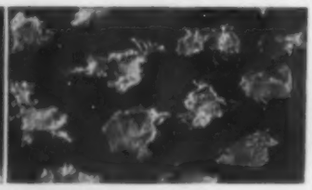
Behind the Filler—the **RESEARCH** *that fits it to your need* **EXACTLY**



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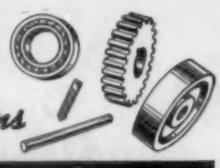
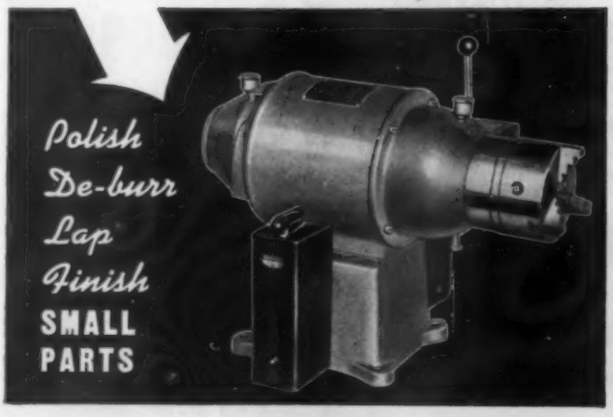
for Secondary Operations





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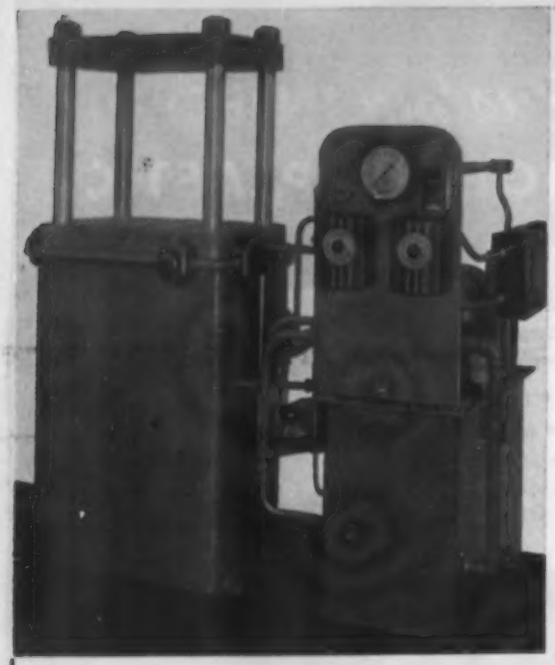

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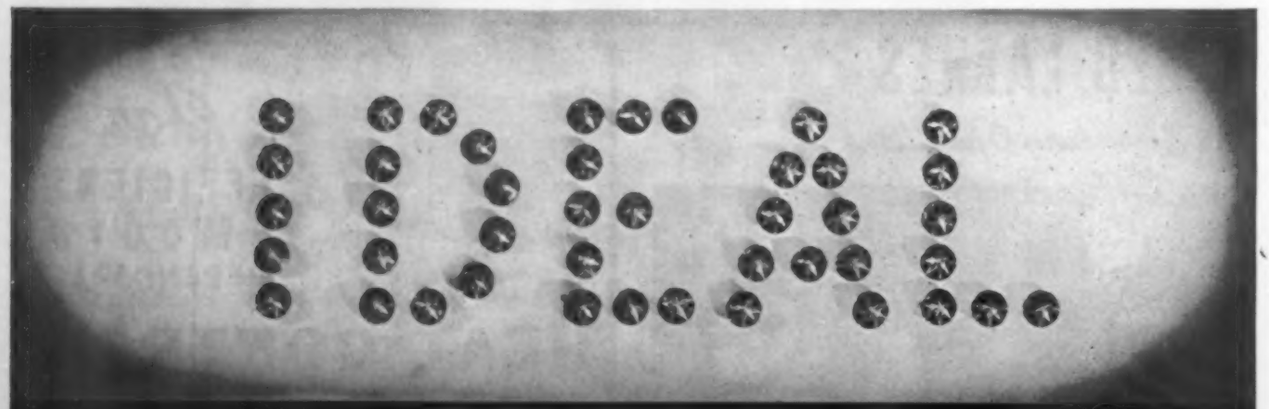

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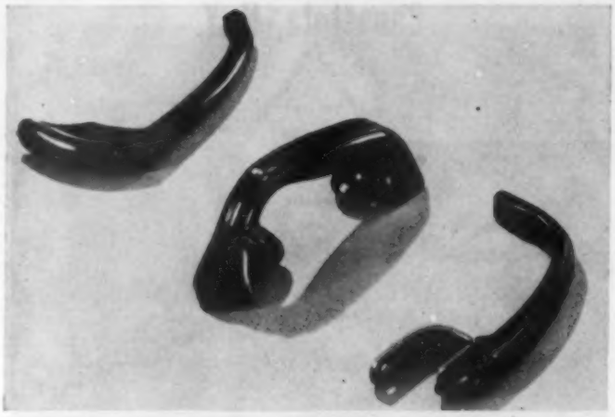

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MODEL #1

Single Door Height: 50" Width: 24½" Depth: 28½"

Heating Element: 1800 Watts

Unit has five trays, 15" × 22½" each holding 10 lbs. of molding powder

Thermostatic Control Range: 100°–300° F. Current: 110 Volt A.C. Standard Equipment

Also can be supplied for 220 Volt Single phase A.C. at slight additional cost.

MODEL #2

Double Door Height: 50" Width: 48" Depth: 28½"

Heating Element: 3600 Watts. Unit has 10 trays 15" × 22½" each holding 10 lbs. molding powder

Thermostatic Control Range: 100°–300° F. Current: 110 Volt A.C. Standard Equipment.

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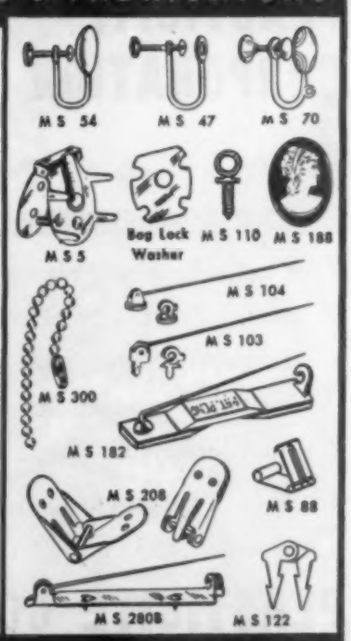

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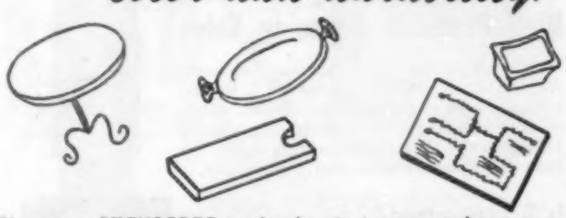

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SIMONDS SAW

(with Cutting Points of Tungsten Carbide)

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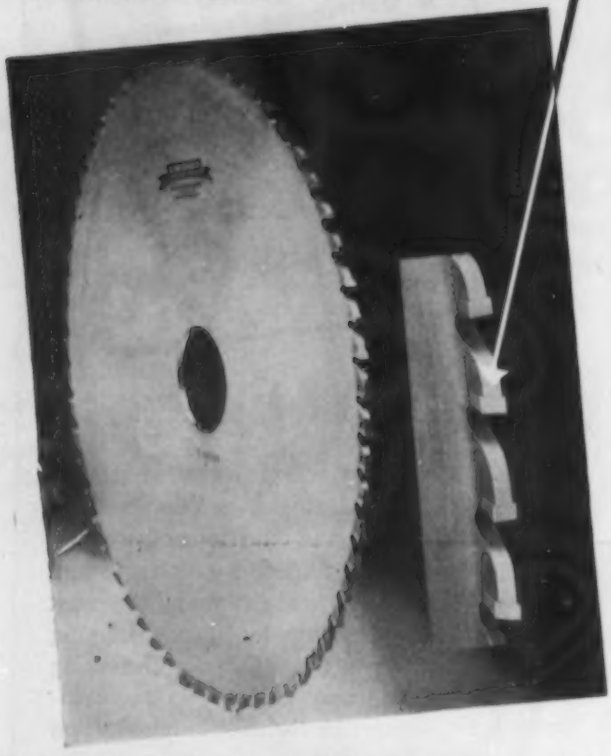

On all jobs except those requiring a fine-tooth saw, this Simonds Circular Saw is the top performer . . . especially where there is abrasive action or heat from the material being cut. With reasonable care not to chip the super-hard cutting tips, it can outlast any other saw, between sharpenings, on the same job. These tips are formed to shape with proper clearance on sides and top, and can be set differently for smooth sawing and for heavy cuts. Then for other jobs and conditions in plastic-cutting, Simonds also make Solid-Tooth Circular Saws of high-speed, semi-high-speed, and special alloy steels . . . as well as Band Saw Blades (including the new Skip-Tooth type) for cutting shapes and circles.

SEND FOR FREE BOOK telling how to choose the right saw for each job, and how to take care of it and get the best results out of it. Write for your copy now.

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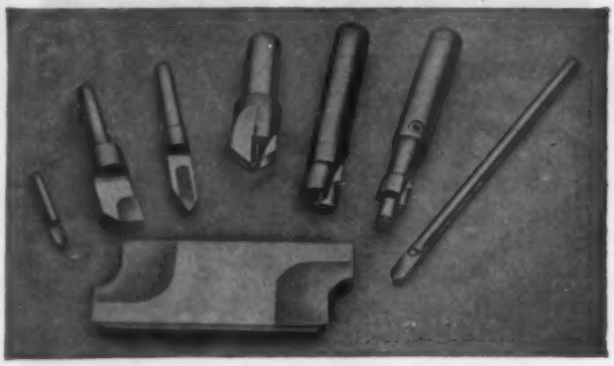

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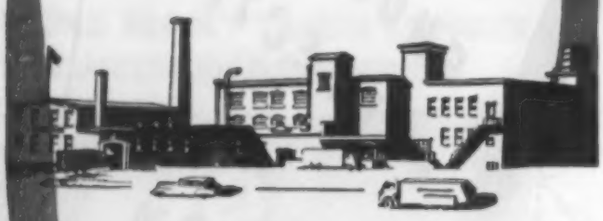

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"GAMCO" *features*
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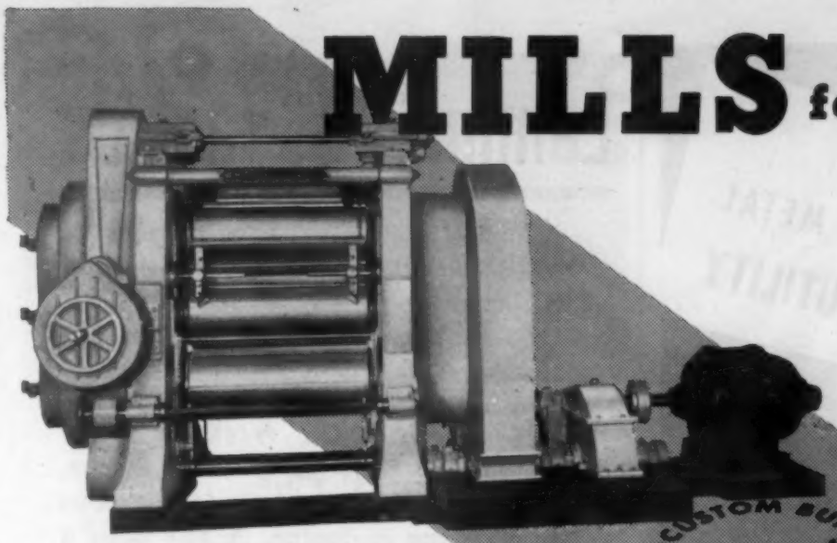

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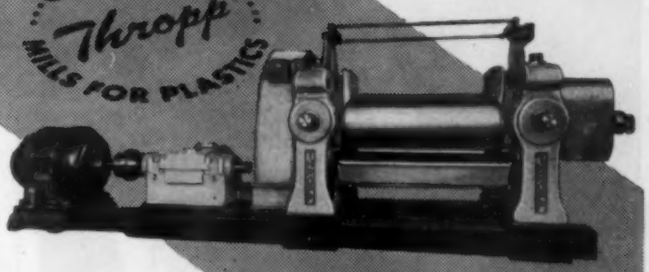

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These bearings are designed to provide the finest precision service available, as well as provide a bearing with circulating lubrication that does not leak.

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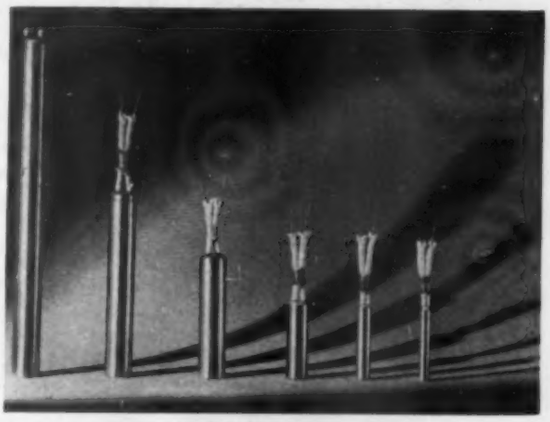
for the Plastics Industry



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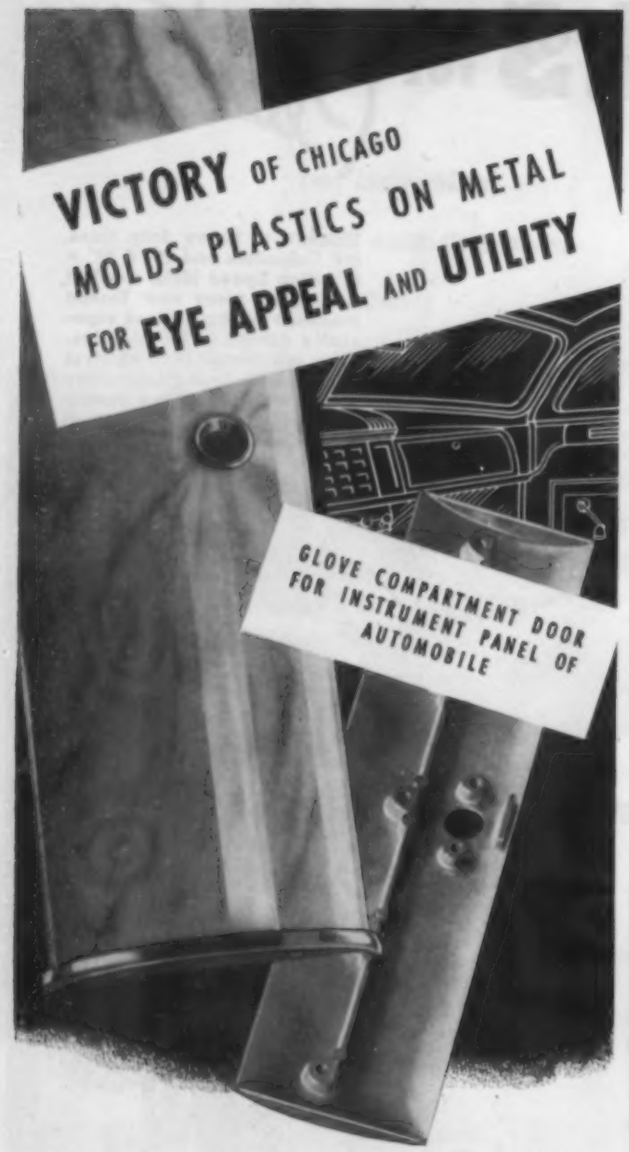

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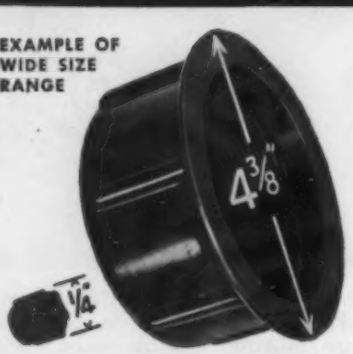

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OPPORTUNITY: We are a reputable principal ready to pay you cash for quick purchase on industrial plants, mfg. divs. or units (assets or capital stock). For immediate action in the strictest confidence address: Box No. 1230, 147 W. 42 St., New York 18, N. Y. Personnel will be retained wherever possible.

FOR SALE—1—30" x 60" Press, 6 Posts, 2—25" dia. rams; 1—12" x 12" Press 7" Ram, Steel Heated Platens and Hand Pump attached; 1—24" x 24" Adamson, 10" ram, 2-opening Hydraulic Press; 1—24" x 24" Farrell, 10" ram, 2-opening Hydraulic Press; 1—30" x 30" D & B, 2-open, steel heated Platens 12" ram; 2—La Pointe Hydraulic Pumps, 150 G.P.M.—2000 lb. pressure direct motor driven to 125 HP AC motors; 1—Housatonic #2 Tuber 3¼" dia. worm; 1—French Oil Hydropneumatic Accumulator; 1—14" x 24" Press, 9" ram; 4—24" x 55" steel cord Heating Platens; 6—Hydraulic Presses, 20" x 20", 12" x 14"; Dry Powder Mixers; Pulverizers, Grinders, etc. Send for complete list. Reply Box 1545, Modern Plastics.

For Sale Royal #3 extruder, new condition. Reply Box C162, Modern Plastics.

WANTED: THERMOPLASTIC SCRAP or rejects in any form, including Acetate, Butyrate, Styrene, Ethyl Cellulose, Acrylic and Vinyl Resin material. Submit samples and details of quantities, grades, and color for our quotations. Reply Box 508, Modern Plastics.

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WANTED
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Plastic Injection Molding
Manhattan
Must be experienced and able to handle men. Furnish detailed information regarding experience, ability and salary expected. Reply Box C155, Modern Plastics

WANTED: Contact with makers of plastics (raw materials) and of machinery for impression molding. Especially for wall-panel production. KURT J. AARNES, Stortings Pl. 7, Oslo, Norway.

OPPORTUNITY WANTED: 35, take work seriously. General Plastic knowledge, Woodpatternmaker, understand molding, fabricating and machining. Can invent, design production jigs and machines. Natural ability for creating, designing modern and futuristic products. Have years experience in supervision and developing production methods. Business managing experience. Will take up residence anywhere. Reply Box C156, Modern Plastics.

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VINYL SCRAP—25 Tons safety glass sheeting scrap for sale. Reply Box C160, Modern Plastics.

PLASTICS ENGINEER—6 years' diversified experience in aircraft consulting and educational fields. Specialized in low pressure laminating and product development. Desires responsible, permanent position with progressive company as a research, product development, or technical service engineer. West Coast preferred but will locate anywhere in the United States or South America. Reply Box C 159, Modern Plastics.

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WANTED: Expert injection machine operator. Must have experience with all types of molding materials and setting of dies. Reed Prentice equipment throughout. Excellent opportunity and future. Reply Box C161.

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Sales Engineer—Firm with extensive model, moldmaking and molding facilities, would like a man with established contacts in various fields, who can do a large volume of custom molding business. We have in mind permanent affiliation with such an individual. Reply Box C163, Modern Plastics.

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Overnight Air Express anywhere in U.S.A. Plexiglas, Lucite, Cellulose Acetate, sheets, rods, tubes, clear or colored, for emergency needs, product development, etc. Full range of sizes, large or small quantities. Also cements, dyes, polishing compounds, buffs. Free price list. Plastic Parts & Sales, 1157 S. Kingshighway, Dept. M-2, St. Louis 10, Mo.

QUESTION: We mold many plastics specialty items, using a number of different materials and molds for "short runs" in the same machines. What heat control method is so versatile that it can be adjusted often and easily to take care of these different jobs?

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The Celectray Controller is just one of a wide line of TAG Controllers for the plastics industry. All TAG instruments are designed to give the user accuracy always. TAG engineers are prepared to recommend, without obligation to you, the particular instruments best suited to your needs. Write for literature.

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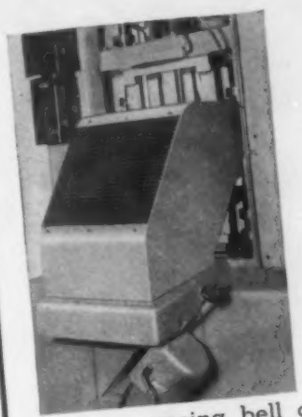

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